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Return to:

# INSTITUTE OF GAS TECHNOLOGY

THE GAS INDUSTRY'S OWN EDUCATIONAL AND RESEARCH FACILITY

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# GAS ABSTRACTS

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# CONTENTS


1. **Management**—Gas industry progress, business problems, statistics, government regulation, safety, personnel, education..... 125

2. **Energy Supply and Economics**—Resources, reserves, and competitive applications of the fossil fuels and other sources of energy, including nuclear and solar energy..... 127

3. **Natural Gas and Petroleum Production**—Geology, exploration, drilling, well management, reservoir engineering..... 129

4. **Gas Conditioning and LPG Recovery**—Condensate, dust, $CO_2$ and sulfur removal, dehydration, odorization, oil fogging, humidification; LPG recovery and refining..... 132

5. **Natural Gas Transmission**—Pipelines, compressors, dispatching, flow regulation, communications, maintenance..... 133

6. **Gas and LPG Storage**—Holders, pressure tanks, underground storage; liquefaction, refrigerated storage..... 135

7. **Manufactured Gas and Chemical Processing**—Gasification of coal, oil; reformed gas; chemical treatment; byproducts; synthesis gas production and conversion; petrochemicals; catalysts, catalyst development..... 136

8. **Gas Distribution**—City utility systems: design, operation, maintenance; weather influence on peak loads and supply; LPG-air mixtures..... 140

9. **Gas Fuel Utilization and Appliances**—Domestic, commercial, industrial; burners; combustion research; air pollution..... 141

10. **Equipment and Instrumentation**—Production and handling equipment, and maintenance; computers; controls; measurement..... 144

11. **Materials of Construction, and Corrosion**—Metals, refractories, plastics; corrosion measurement, prevention..... 145

12. **Analytical Methods and Tests**—Standard and research techniques for gas-making materials, products, processes; instrumental analysis..... 146

13. **Basic Science**—Chemistry, physics and basic engineering related to gas technology; physical properties of gases: phase equilibria, thermodynamics, reaction kinetics, heat and mass transfer, fluid flow..... 147

**Services Available to Readers**—Photocopies, microfilm, Russian translations, bibliographies and literature searches, *Gas Abstracts on Cards*, back numbers of *Gas Abstracts*.....**Inside Back Cover**

**Publications Abstracted for Gas Abstracts**.....**Back Cover**



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## 1. MANAGEMENT

### Gas Industry Management

**El Paso Natural Gas Company. The Story of Growth with Service.** J. F. Ebdon. *Gas 37,* 125 (1961) May (13 pp.)

El Paso Natural Gas Company had its start in 1928, when it began planning around three gas wells and 200 miles of 16-inch line. Today, the Texas-based company extends its transmission system to the Pacific Ocean in the west; slightly across the border into Mexico on the south; to the Canadian border on the north; and to the west, southwest and Panhandle portions of Texas in the east. Three major EPNG mainline gas transmission complexes cover the West. Three systems give the company a daily delivery capacity of 3,459,000 MCF of natural gas at 14.9 psia. Additionally, some 200,000 MCF/day of interstate and field sales can be handled by the existing system. Article discusses the men and physical properties of the pipeline sytsem.

**A Refresher Course in Gas Production, Transmission, Distribution, Utilization. Part 1. Introduction.** I. Deutsch. *Gas 37,* 74 (1961) May (5 pp.); **Part 2. What Is Gas?** *Ibid.,* 71 (1961) June (4 pp.)

Series of articles is designed to present the important technical, economic and practical properties, laws and practices of the gas industry in a terse, concise manner for those desiring an overall picture, those seeking a basic understanding of the industry, and for those in the industry desiring a review. Part 1 describes the position of natural gas in the overall energy picture by briefly tracing the history of the gas industry. Part 2 reviews fundamental concepts of chemistry and physics in order to lay groundwork for subsequent articles. Avogadro's law, Boyle's and Charles' laws and pressure-volume-temperature relationships are among the basic ideas reviewed.

### Education

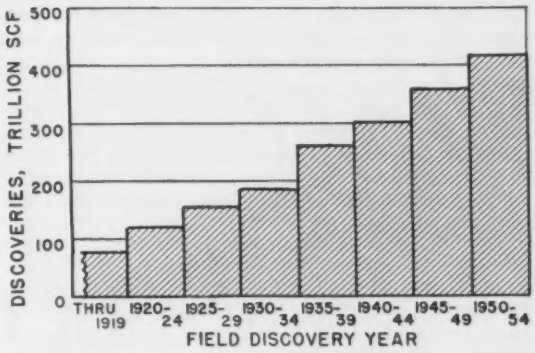
**The LP-Gas Industry Needs More Gas Technicians.** W. L. Thomas. *LP-Gas 21,* 25 (1961) June (2 pp.)

There is one school in the U. S. training gas technicians —Southern Technical Institute, a unit of Georgia Tech. This program currently has approximately 40 students. The program was established by LPGA and is accredited by Engineers' Council for Professional Development, which is the organization which accredits engineering schools in the U. S. The Institute of Gas Technology in Chicago offers a four year program in gas fuel. The gas industry hires many mechanical engineers; yet most schools offering a four-year degree in mechanical engineering spend more time considering combustion of liquid and solid fuels than they spend in the combustion of gaseous fuels. The future of the industry, rests with progress. New and better products, more efficient operations, and men who are trained in this field are needed.

### Federal Power Commission

**Reform and Reorientation of Natural Gas Regulation.** R. B. Eckles. *Public Util. Fortnightly 67,* 733 (1961) May 25 (5 pp.)

**Cumulative Gas Discoveries to Jan. 1, 1960 Now Assigned to Fields Discovered in Five-Year Periods Shown**




(Adapted from *Proved Discoveries and . . .*
See abstract, p. 128)

Author believes that some careful consideration should be given to the need of orientation in natural gas regulation. It is not simply a matter of reorganizing the Federal Power Commission or reforming regulatory procedures. It may be that traditional utility concepts may have to be overhauled.

### Foreign Activities

**Aramco's 1st Miscible Phase Injection Project a Giant.** K. G. Miller. *Petrol. Eng. 33* (Drilling and Producing), B-26 (1961) June (2 pp.)

The Arabian American Oil Company plans to enter the field of miscible phase injection on a large scale. Construction is well under way on facilities to gather approximately 55,000,000 SCF per day of low-pressure gases, liquefy them by compression and cooling, and inject the resulting 37,000 bbl per day of raw LPG into Ain Dar Reservoir. This project will be Aramco's next step in conservation and to improve reservoir ultimate recovery. The company is presently operating two gas injection plants, each handling about 200,000,000 SCF per day of high-pressure gases, plus a water injection system which puts 300,000 bbl per day into the ground. The new plant will, however, be Aramco's first venture into a miscible phase injection operation. Aramco's interest in miscible phase injection dates back to 1957 when an experimental program was initiated to develop data on the benefits to be expected by miscible displacement of Arabian reservoir fluids.

**Pemex in Perspective.** *World Petrol. 32,* 41 (1961) June.

Almost a quarter century has passed since the expropriation decree was signed into law on March 18, 1938 and shook the oil world to its foundations. The government's monopoly for oil, Pemex, was established in that same year, a young fledgling with a difficult road ahead and few trained technicians to guide it. Pemex is not in an easy position. Forced to concentrate on refining at the expense of exploration; its production cushion has

shrunk. Using the forecasts of 6.5% annual increase in demand which Pemex supplies in this issue, it seems likely that a serious production shortage may be in the offing. The financial and energy burden on Pemex will undoubtedly increase steadily in the years ahead. Petroleum now supplies 92% of the total energy used in Mexico, and every increase in energy use means Pemex must supply most of it. The tragedy lies in the fact that the funds it invests are funds that the government is thereby deprived of for use in education, transportation and other governmental functions for which it is directly responsible. They are funds which could be readily obtained from private sources, given the proper legal framework.

**Presidential Address: "We Live Today in the Most Interesting and Exciting Period in Our History."** H. S. Cheetham. *Gas World 153,* 727 (1961) May 20 (5 pp.); *Gas J. 306,* 229 (1961) May 17 (6 pp.); *Gas Times 95,* 19 (1961) May.

Address delivered at 98th annual general meeting of the Institution of Gas Engineers (Great Britain), points out that there is no doubt that all the industrial nations of Western Europe are already making great use of the extended sources of gas supply. The significant roles now being played in some countries by supplies of gas from industries other than the carbonizing industries, and by natural gas, are likely to increase in importance wherever supplies of such gases are available at attractive prices. Great Britain now has in operation and under construction, in the gas industry, high-pressure, oxygen-using plants gasifying coal and oil, and other plants reforming rich gases at high efficiences. But these efforts will be of little use without the availability of a cheap feedstock.

**The Gas Industry of the U.S.S.R.** A. P. Agishev. I.G.E. Comm. No. 590. *Gas World 153,* 736 (1961) May 20 (4 pp.); **Discussion.** *Ibid.,* 795 May 27 (3 pp.); *Gas Times 95,* 27 (1961) May (3 pp.)

In the Soviet Union, the problem of supplying gas to an ever-increasing number of consumers has involved an expansion in the amount of work associated with the utilization of gas for domestic and industrial purposes. The relationship between the requirements of gas for domestic and industrial purposes arises out of the directives of the Seven-Year-Plan, according to which "over 80 percent of all the gas extracted is to be used by industry." In 1959, industrial undertakings in the Soviet Union took 55.4 percent of all the gas extracted, power stations 29.6 percent, and communal life requirements, together with other consumers, 15.0 percent.

## Gas Central Power

**Gas Does Everything at Park Plaza.** M. Hughes. *Am. Gas J. 188,* 25 (1961) June (2 pp.)

An all-gas central power plant that takes care of all energy requirements, including lighting, heating, and year-around air conditioning, is the unseen but vital feature of the impressive new $5,000,000 Park Plaza Shopping Center in Little Rock, Arkansas. Nucleus of the all-gas plant is a gas-fueled 1250-hp turbine driving an electric generator to provide 900-kw for the shopping center. That's enough power for an estimated 5000 homes. Exhaust heat from the gas turbine is utilized to produce steam for the center's winter heating season —and in summer, the steam is utilized in two 252-ton absorption refrigeration units to provide chilled water for summer air conditioning. The turbine produces the base load power supply for the center. Supplementing it are two gas-fueled engine-driven 400-kw generator sets used to provide peak power and for standby whenever the turbine is off-line for adjustment or routine maintenance.

## Industrial Heating

**The Industrial Use of Town Gas for Drying, Processing and Heating.** F. J. Brewer and H. N. Ballantyne. I.G.E. Comm. No. 591. *Gas World 153,* 761 (1961) May 20 (2 pp.); *Gas Times 95,* 43 (1961) May (2 pp.)

Value of a planned approach to the building up of some aspects of the industrial load is emphasized by the authors. While experienced industrial gas engineers have the advantages of a depth of knowledge of the application of gas in industry, it might well be that in many instances there is insufficient knowledge of the industry or processes for which the apparatus or plant is required, with the consequential inability to provide a complete service. This service begins way back in the production line and finishes well beyond the gas-consuming plant.

## Personnel

**Personnel Problems in Electronics.** F. J. Frederick and W. A. Shipman. Paper No. GSTS-61-2. (New York: American Gas Association, May 1961; $0.25)

In their discussion, authors define "electronics" to include communications, automation including telemetry, remote and supervisory control, and data processing. The paper deals with the people who are supplying the increasing needs for new skills in the gas industry. These new skills are required to plan, operate and maintain then increase electronic system usages which have occurred in the last decade.

## Pipeline Construction

**$750 Million Is Pipeline Tab for Next Five Years.** M. I. B. Radcliffe. *Can. Gas J., 54,* 29 (1961) Apr. (5 pp.)

Magazine's nationwide (Canada) survey indicates bright future for pipeliners and the natural gas industry at large. Highlights of findings are: total investment during 1961 will be $427 million—$387 million for transmission and accessories, $40 million for distribution; between now and 1965, investments for transmission will total an additional $250 million, and for distribution a further $28 million; major pipeline projects for 1966-70 will include 8000 inch miles of pipe each year, equivalent to 1300 miles of new system or looping of existing lines. Extensive developments in Alberta are indicated.

**The Constant Revolution in Pipeline Techniques.** A. J. Cressey. *Can. Gas J. 54,* 40 (1961) Apr. (2 pp.)
Author reviews changes during the last ten years, and notes effects that specialization and efficiency have had on bidding and on the job as well.

### Research

**A Report on AGA's Line Pipe Seminar.** K. Kridner. *Gas 37,* 117 (1961) June (4 pp.)
During a seminar session of representatives of 39 gas companies, L. T. Potter set the pace for the meeting when he remarked "In our industry, we need more research planning. This must come not only from those who are scientists and technicians, but also must include the thoughts and abilities of management". A full report from the personnel of Battelle Memorial Institute was presented on its activities researching design and materials for line pipe under the supervision of the line pipe research committee of AGA. The basic intent of the research program was the formulation and instrumentation of a constructive program for the gas industry that would continue the excellent safety record that has been compiled by gas companies in their operations to date.

**Coal Research Organizations: Their Activities and Publications.** M. S. Esfandiary. *U. S. Bur. Mines Inf. Cir. 8008.* (Washington, D. C.: U. S. Govt. Print. Off., 1961; 64 pp.)
A list of both foreign and domestic organizations that conduct research and development programs on coal has been compiled by the Bureau of Mines with the thought that such a directory may provide a useful guide to worldwide research efforts in the areas designated and may facilitate communication between organizations with similar interests. This list includes government, university, private, and commercial organizations. Many of these groups are conducting comparatively modest but often particularly interesting or specialized investigations. Areas of investigation have been defined very broadly.

**Research and Technologic Work on Explosives, Explosions, and Flames, Fiscal Years 1957 and 1958.** R. F. Brinkley and R. W. Van Dolah. *U. S. Bur. Mines Inf. Cir. 7999.* (Washington, D. C.: U. S. Govt. Print. Off., 1961; 30 pp. $0.25)
Purpose of report is to acquaint the public with the work of the Federal Bureau of Mines in explosives technology. Part I reviews briefly the overall activities during the fiscal years 1957 and 1958. Part II presents, in abstract form, the publications prepared by the Bureau that appeared during the period.

**An Approach to Research Planning.** G. F. Pappas and D. D. MacLaren. *Chem. Eng. Progress 57,* 65 (1961) May (5 pp.)
Approach to research planning for development projects has been proposed which is based on a critical appraisal of the ideas available to be exploited in the near future. Incentives and estimated research costs are first determined for each project on a present worth basis, taking into account rate of application and time of need. Once the general basis for the incentive calculations is well understood, it is possible to undertake the next steps of estimating how fast incentive decreases if a project is delayed and making subsequent allocations.

### Safety

**Gas and Heat Evolution from Thermally Unstable Materials.** O. B. Cecil and W. E. Koerner. *Ind. Eng. Chem. 52,* 475 (1961) June (4 pp.)
Quantitative heat and gas evolution data are needed in engineering design to facilitate correct sizing of equipment and to ensure proper choice of safety monitoring systems. Gas evolution can readily be detected by measuring pressure buildup in the decomposition cell. A hydraulic system and external strain gage are used to provide a record of pressure as the temperature of the sample is increased. Data from a typical experiment are presented.

## 2. ENERGY SUPPLY AND ECONOMICS

### Fuel Cells

**Target: More Versatile Fuel Cells.** *Chem. Week 88,* 43 (1961) May 27 (3 pp.)
At least a dozen companies are today working in a special phase of fuel cell research—that concerned with regenerative cells, in which the chemical reactants can be regenerated and used again. Six of a dozen papers on fuel cells given at the Power Sources Conference in Atlantic City about mid-May were concerned with such cells. Object of such all-out effort—versatility—to permit fuel cells not only to convert chemical energy into electrical energy, but also, by application of electrical, thermal, or photochemical energy, to do a couple of other jobs. One is to reverse the process and store electrical energy; another function is to convert nonchemical energy into electrical energy. Conversion of nuclear heat to electricity is one big goal of the work, and storage of solar energy (generally first changed into electricity by solar cells) is another target, especially for space uses.

**Fuel Cells—Electrochemical Converters of Chemical to Electrical Energy.** J. Weissbart. *J. Chem. Education 38,* 267 (1961) May (6 pp.)
Author briefly reviews the historical evolution of the concepts leading to the development of a fuel cell, discusses thermodynamic and kinetic considerations in fuel cell design, and lists some of the fuel cells currently under development.

**Fuel Cell and Method of Producing Electrodes for Such a Cell.** G. H. J. Broers. U. S. 2,980,749 (1961) Apr. 18.
High-temperature fuel cell for the galvanic combustion of gaseous fuels at temperatures between about 450°-750°C is claimed. Cell comprises a casing, a thin, rigid, solid porous carrier impregnated with a molten mixture of alkali metal carbonate as a semisolid electrolyte, and

power-form electrodes of opposing polarity, in contact with, and attached to, the semisolid electrolyte, of thin layers of separate presintered metal powder grains. The electrodes have a low flow resistance to the circulating gases, and maintain a low concentration polarization. Metal gauzes contact both layers of the powder-form electrodes. These gauzes are resistant to both the circulating gases and the electrodes.

### Natural Gas

**Natural Gas in the U.S.A.** G. Manners. *Coke and Gas 23,* 181 (1961) May (5 pp.)

Author writes about the impact of natural gas upon energy patterns in various regions of the United States, the economic effects of natural gas, and natural gas and the generation of electricity. He warns of the limitations of generalizing about a fuel throughout an economy as large and varied as that of the United States, and underlines the importance of realizing that there is not one energy economy in such countries, but rather that there are a whole series of regional energy economies in which the ability of different fuels to compete with each other has distinctive geographical variations.

**Natural Gas, World's Third Ranking Energy Source—A Report on Development and Status of Natural Gas Industries in Natural Gas Producing Countries. III.** H. Laurien and G. Wedekind. *Erdol u. Kohle 14,* 308 (1961) Apr. (6 pp. German text.)

Last article in series concerns the natural gas industry of the Soviet Union and other countries in the Eastern Hemisphere. Earlier articles dealt with the United States and other American countries, and, subsequently, with the natural gas industry in Europe (see *Gas Abstracts 17,* 76 and 99).

### Nuclear Energy

**Recent Developments in Nuclear Power.** H. B. Cohn and S. E. Davis. *Public Util. Fortnightly 67,* 829 (1961) June 8 (7 pp.)

So-called competitive nuclear power is still in the offing. And while this country may have to wait before a utility company can decide to build a nuclear power plant on the basis of its own economic performance, much progress is being made in developing engineering know-how, safety regulations, insurance, site location, and other questions are being constantly explored and re-examined. There are today in the United States five nuclear power plants capable of producing significant amounts of electric power. Eleven additional nuclear power plants are expected to begin operation within the next two years.

### Oil Shale

**Retorting Process and Apparatus.** R. F. Deering, R. O. Dhondt, J. R. Hunt, A. E. Kelley and C. J. Welsh (assigned to Union Oil Co. of Calif.) U. S. 2,980,592 (1961) Apr. 18.

In a shale treating retort apparatus for passing solids upward through a kiln and removing ash from the kiln top, an improved scraper device is claimed. This comprises a scraper bar, inclined horizontally, extending from the kiln periphery to a support at the kiln centerline. The support, which can be rotated, also carries a horizontal scraper bar, the two bars acting upon the rising ash column to remove excess, and to leave a heaped central pile for cooling before removal.

### Reserves

**Report of the National Petroleum Council Committee on Proved Petroleum and Natural Gas Reserves and Availability.** May 15, 1961. National Petroleum Council, Washington, D. C. **Ancient Fields Are Still Adding to Reserves.** *Oil Gas J. 59,* 101 (1961) May 29 (2 pp.)

Report prepared by the National Petroleum Council's Committee on Proved Petroleum and Natural Gas Reserves should be seriously studied by those interested in predicting the year in which the United States will run out of oil. Carefully-worded document tabulates data according to discovery wells, but warns that these data do not measure discovery trends. In fact, the tabulation is not even a valid measure of the amount of oil already discovered. The reason: there are constant revisions—most of them upward—of previous estimates for any given field. These revisions continue for many years.

### Tar Sands

**Process and Apparatus for Bituminous Sand Treatment.** A. E. Kelley (assigned to Union Oil Co. of Calif.) U. S. 2,980,600 (1961) Apr. 18.

Process for hydrocarbon recovery from natural bituminous sand deposits is claimed, in which the raw sand is first pulped with an aqueous alkaline silicate solution mixed with light gas oil as diluent. The improvement comprises a cone-baffled column separator, with deflection baffles arranged to divert sand from the center to the wall and back again during its downward passage. At each wall contact point, the sand is separated from the pulp liquid, which is withdrawn upward, and fresh solution is injected below. The level of the withdrawal pipe is adjusted to maintain oil removal only at each wall zone.

### Thermoelectricity

**Thermoelectricity: Principles and Applications.** J. Jansen. *A.G.A. Monthly 43,* 11 (1961) June (3 pp.)

In the 1950's, the research in semiconductors brought about materials which made it eventually possible to convert heat directly into electricity. For possible application in the gas furnaces, water heaters, refrigerators, and similar apparatus, two forms of construction are possible. In the first, the generator is an independent unit that can be built in already existing apparatus. In the second, the generator is part of the apparatus. The advantage of the second arrangement over the first is that the efficiency of the generator is not important since the heat flows unaffected through the sheet or module. There is no energy loss. The module-type arrangement has an advantage over the sheet in that replacement is simplified in case of a breakdown.

## 3. NATURAL GAS AND PETROLEUM PRODUCTION

### Corrosion

**How We Are Fighting Corrosion.** H. D. Holloway and T. W. McSpadden. *Oil Gas J. 59,* 146 (1961) May 29 (4 pp.)

Economic analysis for every lease where salt water is involved should include some consideration of corrosion and the additional expense of operation and equipment replacement, say authors. Use of coated or nonmetallic equipment is the most popular way of combating corrosion. But coating application requires good workmanship to avoid holidays. Corrosion problems will increase in the future with more severe oil recovery methods.

### Drilling

**First Canadian Electric Rig Working in Swan Hills.** *Drilling 22,* 52 (1961) May (2 pp.)

Modified for diesel electric power, Cascade Drilling Co.'s Rig 21 scores a Canadian first. After being changed from mechanical to electric rig configuration, the apparatus was moved from the company's Edmonton (Alberta) yard, 150 miles north of the Inverness area of Swan Hills. Rig is adaptable to air transportation, is designed to operate from 5000-11,000 feet, weighs 390 tons, and will move in 31 truckloads. Replacement cost is estimated at $600,000.

**How Pipe and Hole Size Affect Drilling Hydraulics.** P. L. Moore. *Oil Gas J. 59,* 143 (1961) May 29 (2 pp.)

Research is discovering that more and more frequently poorly chosen pipe and hole sizes are the basic reasons for poor hydraulics and higher-than-necessary drilling costs. Whether surface pressure is limited or not, efficiency of the hydraulics program goes up as drill-pipe size increases. If surface pressure is limited, the same thing is also true for hydraulic impact. However, when surface pressure is not limited within the range of design, a circulation rate can be selected which results in about the same bottom-hole impact regardless of pipe size.

**How to Evaluate Pipe Stresses When Drilling from a Floating Vessel.** E. R. Lind. *World Oil 152,* 95 (1961) June (7 pp.)

The following stresses increase with hole depth: axial tensile stress due to the weight of the tubing; bending stress due to the vessel being displaced from over the hole; and bending stress due to the vessel roll. As the hole depth increases, the roll and/or the displacement limits must be decreased to prevent overstressing the pipe. To prevent failure by bending or breaking, it is necessary to keep the maximum total stress below a predetermined maximum allowable working stress. This maximum allowable working stress depends upon all of the physical properties of the string plus the past history of the operation and can only be determined by operating experience.

**New Turbodrill Simplifies Directional Drilling.** S. R. Ghavami. *Petrol. Eng. 33* (Drilling and Producing), B-34 (1961) June (3 pp.)

The turbodrill has not yet been developed to the point where it is commercially competitive with conventional rotary drilling in the United States. The most impressive results with the turbodrill have come from Russia where the tool is used in the majority of wells drilled and in all directional wells. However, Russian experience has pointed up several disadvantages in the design of the turbodrill. To overcome these, a new type turbodrill has been developed in Russia. With the new type drill, starting and stopping can be controlled at will. Construction and use in directional drilling are discussed.

**Project Mohole Demonstrates Deep Water Drilling Techniques.** G. M. Wilson. *World Oil 152,* 84 (1961) June (7 pp.)

An experimental deep sea drilling program designed to test floating vessel equipment and techniques will be used later—perhaps several years hence—in drilling the ultimate Project Mohole. The final phase of the project, site for which still has not been determined, will be an attempt to drill through the earth's crust to reach and sample the mantle, the material which comprises 84 percent of the earth's volume. In shakedown operations in 3140 feet of water off La Jolla, near San Diego, drilling and coring was done in five exploratory holes, the deepest being 1043 ft. In 11,700-foot water tests in open ocean between Guadalupe Island and the Baja California coast, six holes were drilled, the deepest was 601 ft. Miocene sediments were cored almost immediately in the ocean floor, and hard basalt was encountered from about 560 ft. to total depth reached at that site.

**New Idea in Drill Pipe Field Tested.** *Petrol. Eng. 33* (Drilling and Producing), B-24 (1961) June (3 pp.)

A patented manufacturing technique makes it possible to provide a pipe incorporating two wall thicknesses in one pipe with a smooth internal taper from the heavier to the lighter wall. The departure from Standard API Weights makes it possible to provide extra strength in the slip area while maintaining the regular API weight for the remainder of the joint.

### Drilling Muds

**French Contractor Engineers Mud Manifolding System.** J. E. Gallon and T. E. McDowell. *Petrol. Eng. 33* (Drilling and Producing), B-19 (1961) June (3 pp.)

Hydraulic and drilling engineers of Societe Languedoc de Forages Petroliers with headquarters in Paris have engineered a unique and efficient mud manifolding system for its large drilling rigs. The new system was designed around two centrifugal pumps. Objectives of the engineers were to increase mud pump efficiency; raise mud weights from 9 lb per gallon to 17 lb per gallon in only one circulation (or cycle) of the mud; achieve greater agitation in the mud tanks; degas and desand mud; operate mud pumps in parallel or series; and simplify moving and rig up.

## Exploration

**Exploration for Oil and Natural Gas in Western Germany During 1960.** H. U. Hark. *Erdol u. Kohle 14,* 245 (1961) Apr. (16 pp. German text.)

Survey is given on the exploration drilling activity in Western Germany in 1960. The 94 exploration projects and the most important expansion drillings are discussed in detail. Twelve oil and gas discoveries were made during the year. A further partial field was discovered by an expansion well. Thus, in spite of the decreased exploration activity, the successes reached were considerable. Special attention is called to such noticeable geological results as the promising oil discovery of Hamburg and the evidence of the presence of oil and gas below the Molasse basin. Important paleographic knowledge was won, among others, by the deep drilling projects on the Zechstein base in North Germany as well as some drillings in the Western Molasse which partly came down to the basement formations.

**Drilling's No Problem in Tierra del Fuego.** E. McGhee. *Oil Gas J. 59,* 66 (1961) June 5 (3 pp.)

With full-scale development only one and one-half years old Tierra del Fuego is already adding as much as 20,000 bbl of crude daily to Argentine production. Moreover, four rigs have been drilling continuously and have regularly increased productive capacity. The 64 wells capable of production at the end of 1960 have a maximum-efficient-recovery rate higher than present facilities can carry to market. When transportation facilities are brought up to producing capacity, there should be a big jump in daily crude movements.

**Panhandle Gas Hunt Sets Hot Pace.** B. E. Barby. *Oil Gas J. 59,* **Part 1.** 210 (1961) May 29 (6 pp.); *Ibid.* **Part 2.** 128 (1961) June 5 (3 pp.)

Northwest Oklahoma has been a "wildcatter's dream" with a discovery ratio exceeding 50%. This success ratio has offset errors in geologic thinking when the original objective tested dry, and the well was plugged back and completed in an unexpected zone. Multiple pay zones are found throughout the area, and new producing zones are easily overlooked. All data and maps show only gas statistics and development. Panhandle gas reserves are too vast a subject for a single discussion to cover the 2600 wells involved. Generalizations are both dangerous and incorrect when speaking of reserves, since too many variations exist to apply an acre-foot recovery factor to each zone. Accurate reserve predictions are critical for this area, and daily decisions are necessary with respect to completions and new locations that could mean the difference between profit and loss. Volumetric reserve calculations can be misleading, and are generally inaccurate due to the unknown lateral variations in productive thickness, permeabilities, and porosities.

**Queen Elizabeth Island of Arctic Canada and Their Petroleum Prospects.** A. B. Cameron. *J. Inst. Petrol. 47,* 129 (1961) May (34 pp.)

The Queen Elizabeth Islands have a great variety of geological formations with abundant signs of petroleum substances. There are many large closed structures similar in size to those in the Middle East. Geological field work has supported photoanalytical and photogrammetrical studies. Continuous drilling throughout the year might cost $2,000,000, with a proportionately reduced expenditure if no midwinter operations were conducted. Rapid development could occur, with some oil being exported by tanker direct to West European and East Canadian markets within a year of discovery. Later, a shuttle service should be able to carry oil during a four-month season to intermediate storage in Southwest Greenland, whence it can be transported throughout the year to world markets.

**Rigs Will Be Busy in Alaska This Summer.** F. J. Gardner. *Oil Gas J. 59,* 209 (1961) May 29.

Four important wildcats are already on their way down in Alaska, and several more are in the planning stage. Busiest spot in the state is the Kenai Peninsula where three, and possibly four, fields have been found. A new gasfield has been tapped by Standard Oil Co. of California and Richfield Oil Corp. at the 1 Falls Creek, a directionally drilled wildcat on the shore of Cook Inlet.

## Fluid Flow

**The Flow of Oil and Gas Mixtures in Wells and Pipelines: Some Useful Correlations.** W. J. Baker and K. R. Keep. *J. Inst. Petrol. 47,* 162 (1961) May (8 pp.)

Calculations relating to the flow of oil and gas mixtures in oil wells and pipelines involve the integrals of $(vdp)$ and $(\rho dp)$. General correlations have been obtained from 22 Middle East crudes which enable these integrals to be evaluated for any pressure changes occurring in a well or pipeline. It is estimated that the correlations are about 5-10 percent accurate for oils with stock tank specific gravities in the range 0.80-0.92. A correlation of gas-oil ratio with saturation pressure has also been obtained. These correlations simplify the design of oil well flow-strings and flowliness to the extent that it becomes no more difficult than designing for single phase flow. At the same time, it is only necessary to know the saturation pressure and stock tank gravity of the oil in order to carry out flow calculations within reasonable limits of accuracy.

## Offshore Operations

**In Offshore Louisiana, Some Commercial Oil, Gas Indigenous to Pleistocene.** D. I. Andrews and J. C. Stipe. *World Oil 152,* 122 (1961) June (5 pp.)

Commercial oil and gas are being found in Pleistocene sands in the Louisiana offshore, and these accumulations are in many cases indigenous to the formations in which they occur. Until recently, belief persisted that oil is not indigenous to formations younger than Pliocene. Radiocarbon dating work in connection with some "young" crudes, however, places them in the 5000 to 10,000 year age range. Offshore drilling further southward in deeper waters, shows well developed marine

sands of Pleistocene age which contain substantial reserves of oil and gas, particularly gas. Current reserves in the intermediate facies are concentrated near the present Mississippi River delta, and as it has extended further out onto the continental shelf, the facies have become accessible to present day drilling. Production in the Pleistocene has also been found approximately 100 miles westward and in water up to 100 feet deep.

**How to Operate Offshore Production by Remote Control.** S. H. Miller and A. C. Bradham. *World Oil 152,* 107 (1961) June (6 pp.)

Gulf Oil Corporation has installed a unique supervisory control and data telemetering system for three high-pressure gas condensate wells located in Block 889 near Mustang Island, Texas, in the Gulf of Mexico. Automatic instrumentation provides for control functions; measurement of production variables; alarms and monitoring; and platform security. The system control point is located on the bay side of Mustang Island at the onshore separation and storage facilities. All control functions, signals and process data are transmitted over a single pair of wires through a submarine cable between the offshore platform and the onshore control station.

## Secondary Recovery

**How to Engineer an *In Situ* Combustion Project.** T. W. Nelson and J. S. McNeil. *Oil Gas J. 59,* 58 (1961) June 5 (8 pp.)

The range between 200 and 300 bbl per acre-ft is a fairly broad one to choose from, and a wrong assumption could affect the results of an evaluation appreciably. Therefore, it is best to determine this figure as accurately as possible for the particular crude oil and reservoir conditions involved. This is usually done in a burning tube in the laboratory—an insulated cylinder usually 4 to 8 in. in diameter and 4 to 10-ft long. The tube is packed with sand, water, and the crude oil in question, simulating as nearly as possible reservoir conditions of porosity and saturation. When this tube is burned, observations are made on the amount and rate of air injected, the amount of oil and water produced, and the amount and composition of gas produced. Fuel consumption is determined on the basis of the amount of sand pack burned and the amount of composition of the produced gas.

## Well Practice

**In a Gas Lift Operation . . . Converted Engine Exhaust Supplies Make-Up Gas.** J. E. Kastrop. *Petrol. Eng. 33* (Drilling and Producing), B-21 (1961) May (6 pp.)

New inert gas generator utilizes a catalytic process to convert engine exhausts into a usable product, principally nitrogen. First field use is at Anse La Butte in Southern Louisiana. In this installation, the unit produces about 120,000 CF/day of inert product which will provide make-up volume for the system currently handling from 1.2-1.6 MMCF/day for rotative gas lifting six production wells.

**Oil Well Cementing Practices and Materials.** P. C. Montgomery and D. K. Smith. *Petrol. Eng. 33* (Drilling and Producing), B-28 (1961) June (6 pp.)

Today practically all cement used by the oil industry is unloaded in bulk from cars or barges at bulk stations where it may be formulated with additives before transportation to the well. Modern blending operations offered by the service companies make it possible to tailor cementing compositions to fit most well conditions regardless of volume, depth, or temperature of the well. Several types of additives are used: such as accelerators or retarders, and lightweight materials to reduce slurry weight, increase yields, and lower costs; —heavy weight, to increase density, and restrain pressure; low water additives, to protect sensitive formations, prevent premature dehydration and provide better squeeze jobs; lost circulation additives to restore circulation; provide increased fill up in the column, and to reduce costs; and special additives which may be useful in overcoming certain temperature effects directly influencing strength, or other additives to overcome characteristics which may be harmful to desired cement properties. Many varied types of materials may be used for the purpose.

**Simplified Method for Evaluating Well Streams from Drill Stem Tests.** R. F. Cox. *Petrol. Eng. 33* (Drilling and Producing), B-58 (1961) June (3 pp.)

System covers securing basic data from portable separator, translating it into workable form, then using results of simplified calculations in a useful, self explanatory report for later processing plant feasibility studies. Proper liaison and cooperation between production and drilling personnel and the evaluation engineer, coupled with some planning prior to such testing, can result in the development of well stream evaluation data which can be of immeasurable value to all concerned. Further it can be done at very little added cost to the usual testing expense, and certainly at less cost than at any subsequent time.

**Formation Cement Squeezes by Using Low-Water-Loss Cements. Part 1.** H. J. Beach, T. B. O'Brien, and W. C. Goins, Jr. *Oil Gas J. 59,* 155 (1961) May 29 (4 pp.); **Part 2.** *Ibid.,* 154 (1961) June 12 (3 pp.)

As late as 1955 and 1956, Gulf Oil Corp. was having no better than about 60 percent success in cement-squeeze jobs of its wells in one typical area. Answer to this problem is in carefully formulated slurries with low filtration rates. These can be squeezed into perforations without dehydrated cement to block the casing. Added to these cements is a process of prolonged and intermittent pumping. Such "hesitation" promotes building of cement filter cakes in the open perforations. Just as important as the formulation of the cement is the way in which it is squeezed in the well. Generally, the process is one of pumping in small volumes, then waiting for a time before pumping in a little more. This process first builds up a dehydrated cement cake in the perforations which readily accept fluid. Then as these are plugged, pressure naturally goes up and the more resistant perforations begin to take fluid.

## 4. GAS CONDITIONING AND LPG RECOVERY

### Carbon Dioxide Removal

**First Fluor Solvent Process Plant Now on Stream.** *Petrol. Refiner 40,* 288 (1961) May (2 pp.)

New method for physically removing bulk quantities of $CO_2$ from natural gas has been demonstrated by the successful startup of El Paso Natural Gas Co.'s Terrell treating plant. For the first time, by use of the Fluor Corp.'s solvent $CO_2$ removal process, natural gas containing very high $CO_2$ concentrations (on the order of 40 percent and above) is upgraded to pipeline specifications with attractive economies.

### Dust Removal

**Carbon Separation Process.** D. M. Dille (assigned to Texaco Inc.) U. S. 2,982,635 (1961) May 2.

In generating synthesis gas by partial oxidation of hydrocarbons, a carbon-water slurry is formed in the product gas cooling zones, which is very difficult to separate. The improvement claimed comprises adding to the slurry a water-insoluble long carbon chain fatty acid (oleic acid) and a glyceride of said acid in amounts of 300 to 500% of carbon weight, and drawing the quench slurry to a separation zone where the carbon separates as a floating layer with low water content. Such layer is removed by skimming or decantation. Addition of water-soluble calcium or magnesium hydroxide improves the separation.

**Process and Apparatus for the Purification of Gases.** P. G. Vicard. U. S. 2,983,332 (1961) May 9.

A method is claimed for removing fine foreign particles from gases, which comprises saturating the gas with the vapor of a liquid and then adding more liquid as a mist to supersaturate. The gas is then passed through a Venturi tube to produce a transient pressure drop with sudden cooling. This causes condensation of vapor particles, which are ionized, and the ionized particles are removed on precipitating electrostatic elements.

### Hydrogen Sulfide Removal

**Hydrogen Sulphide Removal by the Stretford Liquid Purification Process.** T. Nicklin and E. Brunner. I. G. E. Comm. No. 593 *Gas World 153,* 744 (1961) May 20 (5 pp.); **Discussion.** *Ibid.,* 841 (1961) June 3 (3 pp.); *Gas Times 95,* 35 (1961) May (3 pp.)

The Stretford Process, developed jointly by the North Western Gas Board (Great Britain) and the Clayton Aniline Co. Ltd., was intended initially for the removal of hydrogen sulfide from coal gas. Subsequent work, however, has shown that the process is suitable for the removal of hydrogen sulfide from gas streams of various composition and from solvents immiscible with water. A continuous liquid-purification system for the removal of hydrogen sulfide from coal gas is generally accepted and is daily becoming more needed. The problems associated with dry box purification are numerous and well known. In addition to labor difficulties, large ground space requirements, dust hazards, etc., can now be added to the difficulty of disposal of spent oxide as a result of the ready availability of pure sulfur on a large scale.

**Regenerating Zeolites Used for Sulfur Removal.** H. W. Haines, Jr., G. A. Wielingen and F. B. Mathews. *Oil Gas J. 59,* 78 (1961) May 22 (3 pp.)

New adsorption process for desulfurization and sulfur recovery which employs alkali-metal alumino-silicates is being developed in Canada for commercial use. It has been found that these synthetic zeolites are excellent Claus catalysts and have high equilibrium capacities for water vapor, carbon dioxide, and hydrogen sulfide. These properties permit simultaneous dehydration and sweetening of natural gas, and direct conversion of the adsorbed hydrogen sulfide to elemental sulfur. The Haines process, as it is known, is similar to those used in short-cycle hydrocarbon recovery units, but uses a totally new type of regeneration cycle.

**Removal of Hydrogen Sulfide from Gases.** D. B. Moore and P. S. L. Cook (assigned to Robert Dempster and Sons, Ltd.) U. S. 2,983,573 (1961) May 9.

A process for removing acidic constituents from gases is claimed, in which at least two continuous compact columns of flowable iron oxide-containing pellets are provided. The purifying oxide is withdrawn from bottom of columns while charging fresh material at top. The gas is passed concurrently down the tower and is withdrawn at an outlet some distance above the tower bottom. Oxygen may be added to purified gas and cycled through lower oxide lock. Oxide may be revived in air and restored to use in the first tower.

**Removing Hydrogen Sulfide from Hydrogen Recycle in Hydroforming Process.** L. N. Jacob (assigned to Sun Oil Co.) U.S. 2,984,615 (1961) May 16.

A process is claimed for removal of hydrogen sulfide from gases, in which the sour gas is contacted in a reaction zone at 150°—300°F and 15—5000 psig with sulfur hexafluoride. The $H_2S$ is converted to elemental sulfur which is removed by scrubbing, settling, etc. The HF can be separated by liquefaction and further used in refining, and the cleaned gases (hydrogen, hydrocarbons, $CO_2$) are removed for use.

### Sulfur

**How Big a Western Sulfur Pile by '65?** *Can. Chem. Processing 45,* 50 (1961) May (2 pp.)

In spite of dire predictions, major Canadian sulfur producers are not too worried about their market situation. Recent detailed market survey indicates that in 1960, total sulfur use in Canada was 875,000 long tons. Production is eastern Canada was about 400,000 tons, while western elemental sulfur came to nearly 450,000 tons. While the production figure is expected to peak sharply, long-term exports are expected to remove the surplus threat.

**Sulfur Plants in Economy Packages—and the Tag for Upkeep is Economical, Too.** H. Grekel, L. V. Kunkel and R. Mungen. *Oil Gas J. 59,* 80 (1961) June 5 (2 pp.)

Eight package sulfur plants have been built by Pan American Petroleum Corp. and its licensees. Operating experience to date has indicated a very low operating and maintenance cost. The major components of the plant include the air blower, the furnace-cooler-condenser, the reactors, and separator-storage drum. In the Claus-type process, one third of the hydrogen sulfide is burned to sulfur dioxide which reacts with the remaining hydrogen sulfide over bauxite catalyst under conditions which will result in the best sulfur yield.

## 5. NATURAL GAS TRANSMISSION

### Compressors

**Push Button Control of Horizontal Gas Engine Driven Compressor Unit.** J. W. Lehman. *Pipe Line News 33,* 18 (1961) May (5 pp.)

Modernization of its older compressing stations, in which twin-tandem horizontal power units are the prime movers, and simplification of station operation have been the objectives of Cities Service Gas Co. (Oklahoma City, Okla.) for the past several years. Most recently, attention has been given to the main engine units at these stations. Before unattended operation could be considered, it was necessary to improve the engine ignition, oil and grease lubricating systems and bearings. Article describes modifications made and installation of push button control for a compressor unit.

### Compressor Stations

**Engines Without Pushbuttons.** B. Osborn. *Gas 37,* 105 (1961) June (6 pp.)

United Fuel Gas Co.'s complicated operations at its Kenova (West Virginia) station can be broken down into two phases. In the first phase, four semi-automatic 2000-hp GMWA engines, in combination with four horizontal engines dating back to the 1920's, form a 12,600-hp complex which pumps rich Appalachian gas to the $7-million hydrocarbon extraction plant built by UFG in 1958. Gas leaving the extraction plant supplies customers in areas such as Cincinnati, Ohio, and Ashland, Ky. Depending on customer requirements, a surplus of 0-85 MMSCF/day may exist downstream of the extraction plant, and it is desirable to remove the surplus gas accurately so that the flow through the plant can remain constant. This is done by four completely automatic 1100-hp gas compressor units which are operated by a fully pneumatic control system. The station is not unattended; one man is always present to observe and report the pressures and flows indicated on the main station panel and to dispatch gas through runs controlled from the panel to areas of western West Virginia and Kentucky and Ohio. The station's operation is described.

### Fluid Flow

**Weymouth Gas Flow Formula Has Limitations.** R. H. Parekh. *Pipeline Eng. 33,* D-51 (1961) June (2 pp.)

Limitations of Weymouth gas flow formula are shown by analysis from basic engineering principles. Weymouth formula has been widely used, both by "longhand method" and by computer programming for sizing of single-phase gas gathering and transmission pipelines. Use of the Weymouth formula for all types of flow conditions is fundamentally incorrect. For gas flow conditions of low Reynolds' Number ($1 \times 10^4$ and less), a gas gathering pipeline system sized by using the Weymouth formula generally will be undersized. For gas flow conditions of high Reynolds' Number ($1 \times 10^7$ and higher) in general, the gas gathering pipeline system sized by the Weymouth formula will be oversized.

### Metering

**Gas Measurement is on the "Skid."** F. H. Love. *Pipeline Eng. 33,* D-20 (1961) June (3 pp.)

Gas transmission pipelines are moving toward widespread adoption of skid-mounted field metering stations because of savings in initial installation and their 100% salvability. Criterion of whether to make a permanent type installation or a portable one is the service for which it will be used. Sales, town border, check, and fuel stations, all of a permanent type, do not necessarily require the portability features of skid mounting. Wellhead, drilling fuel, and farm tap units, on the other hand, are of doubtful permanency and it is here that the economy of the portable units is appealing.

**What's Ahead in Gas Measurement.** E. E. Stovall. Paper No. GSTS-61-1. (New York: American Gas Association, May 1961; $0.25)

Author explores briefly several areas of gas measurements where new methods, principles and/or operations are becoming everyday practice. As examples of progress he cites the mass meter which measures the weight of the gas, and electronic machines which calculate gas meter charts. He predicts that the meter chart itself may eventually be eliminated by devices which transmit meter data directly to electronic machines for calculation. He also believes that research efforts must be promoted to produce an entirely new concept of measurement. One program receiving concentrated support promotes the concept of a common standard pressure base for all types of measurements.

### Pipeline Construction

**Barge-Tug Flotilla to Attack Alaska Crossing.** *Oil Gas J. 59,* 177 (1961) May 15 (2 pp.)

Peculiar characteristics of Turnagain Arm, the 8½-mile stretch of water that is the one unfinished link in the Alaska Pipeline Co.'s gasline from the Kenai Peninsula to Anchorage, make its crossing one of the most difficult pipeline jobs ever attempted. These include more than 30-foot tides, winds that top 100 miles per hour, huge waves, strong currents, and a highly viscous, shifting

bottom. Article describes new, barge-mounted equipment that will be usd in another attempt to lay a dual line across the arm.

**Gimmicks and Gadgets.** H. M. Joiner. Paper No. GSTS-61-10. (New York: American Gas Association, May 1961; $0.25)

Author reviews extensively recent developments in equipment, techniques and operating practices related to all phases of pipeline construction and operation.

**The White River Crossing.** R. Lewis. *Pipe Line News 33,* 34 (1961) May (3 pp.)

Arkansas Louisiana Gas Co. climaxed the construction of their 18-inch pipeline, project "T", with the erection of the White River suspension bridge. The bridging of White River ended almost eight months of work that took Arkla crews and machinery across half the width of Arkansas. The project originated at Perla station near Malvern, Ark., and terminated on the banks of the Mississippi River near Helena. A relatively new principle, conceived and developed by its designers, was used in fabrication and installation of the bridge.

**Pipeline Engineering by Photogrammetry.** B. A. Barry. Paper No. GSTS-61-4. (New York: American Gas Association, May 1961; $0.25)

Planning and selection of the route for a gas transmission line can be accomplished expeditiously by using recently developed techniques of photogrammetry, aerial photographic surveying. In order that the photogrammetric procedure might become more familiar to engineers and others engaged in design, author's paper covers in a fairly detailed manner the basic photo-optical principles of photogrammetry as applicable thereto, and then discusses the manner of utilizing the photogrammetric technique in the specific problem of pipeline engineering.

**Pipelining in the Gas Industry.** W. E. Medhurst. *Chem. and Process Eng. 42,* 203 (1961) May (4 pp.)

Economics of gas transmission depend to a great extent on the proper selection of pipe diameter and working pressure. During the last few years the development of steel as a construction material for pipelines has brought about new methods of pipelaying. Article describes the various operations that are carried out in modern pipeline operations where success depends largely upon continuity of working.

## Pipeline Operations

**Method for Measuring Forces Within a System.** G. Damewood and M. T. Hanchett. (assigned to SGA). U. S. 2,979,940 (1961) Apr. 18.

Method is claimed for measuring forces resulting from acoustic pressure waves acting on a vessel (pipeline) containing a gas stream that flows through the vessel. The stream has a pulsating flow, created by the pumping (compressing) device, which generates acoustic pressure waves of complex harmonics. The method senses the effect of the waves on the vessel at those spaced points where the acoustic energy becomes converted to mechanical energy. The two signals generated have an amplitude and phase angle related to the amplitude and phase angle of the pressure waves. These signals are added and the output recorded. The device enables a study of optimum size and position of tanks, filters, chokes, etc., to decrease the amount of vibration.

**Pipeline Surveying.** H. J. En Dean, D. Jones and E. Topanelian, Jr. (assigned to Gulf Research and Development Co.) U. S. 2,980,854 (1961) Apr. 18.

Apparatus for surveying the inside of a pipe for electrical potential gradients comprises a vehicle insertable in the pipe, a packer connected to the vehicle adapted to form a sliding seal against the wall of the pipe, potential difference measuring means in the vehicle, and recording means in the vehicle connected to the potential-difference measuring means. An improvement is claimed which comprises two electrically conducting contact members being electrically insulated and contacting the pipe at transversely spaced points lying in a plane substantially perpendicular to the longitudinal axis of the pipe, and means for connecting said contact members respectively to the terminals of the potential-difference measuring means.

**Some Problems in Gas Dispatching in Southern Alberta.** G. D. Kellam. Paper No. GSTS-61-3. (New York: American Gas Association, May 1961; $0.25)

Canadian Western Natural Gas Co. Ltd. (Calgary, Alberta), operates an integrated gas system covering the area from the U. S. border northward 230 miles to Red Deer, and from the British Columbia boundry nearly to Saskatchewan, an area of about 38,000 square miles with a population of 425,000. Gas dispatching problems are weather, load factors and communications. Solutions to these problems are not complete, but, author says, company believes a complete solution would be too costly.

## Piping

**New Approach to Pipeline Crossings.** W. E. Riley. *Oil Gas J. 59,* 151 (1961) June 12 (3 pp.)

An economical solution to the pipeline-crossing problem may be achieved by providing a twin-arch pipeline span, in which two inclined arched structures are located side by side and connected together by cross-struts to provide lateral stability. This will also permit relative displacement between two arches in the vertical direction, since relative displacement between the two arches may be employed to carry substances having different weights or temperatures without creating excessive stresses.

**Strict Quality Control Measures in Manufacture of Gas Pipes.** *Can. Gas J. 54,* 44 (1961) Apr. (3 pp.)

At the Welland, Ont., plant of Welland Tubes Ltd., quality control is implicit in every manufacturing operation. The company manufactures 20- to 36-inch outside diameter pipe in a modern plant opened in 1957. The process,

known as cold-expanded electric fusion welded pipe making, includes a considerable degree of automation but still depends on the human eye and hand for three stages out of the four in its inspection system. These check on such essentials as diameter, size, wall thickness, welds and end bevels.

## 6. GAS AND LPG STORAGE

### Liquefaction

**An Experimental Study Concerning the Pressurization and Stratification of Liquid Hydrogen.** A. F. Schmidt, J. R. Purcell, W. A. Wilson and R. V. Smith. *J. Research, C. Engineering and Instrumentation 65,* 81 (1961) Apr.-June (7 pp.)

A 625-gallon powder-insulated Dewar has been built and appropriately instrumented to provide information about pressurization gas consumption, ullage pressure, liquid level, horizontal and vertical temperature surveys throughout the test fluid, and lapsed time. Pressurization levels of 25, 75, 125, and 180 psig have been examined individually. Two techniques—one based on the case of one-dimensional heat flow in a semi-infinite solid and the other founded on an electrical network analog of the thermal system—are given for making reasonable predictions concerning liquid-phase hydrogen temperature distribution in well-insulated, rapidly-pressurizing storage vessels. A thermal analysis is presented which indicates the mechanics of heat transmission and adsorption in the fluid.

**Liquefied Gases: Cryogenic or Pressure Storage?** N. R. Hower. *Chem. Eng. 68,* 77 (1961) May 29 (4 pp.)

It is generally agreed that the best way to deal with a large volume of gas is to liquefy it. The problem is: should liquefaction be accomplished by refrigeration or pressure? Propane, for example, is a liquid at ambient temperature and a pressure of 200 psig, but it is also liquid at −45°F and atmospheric pressure. Author presents an economic-engineering analysis to help determine which system is best under any given set of conditions.

### Methane Liquefaction

**Conch to Ship Liquid Methane from Algeria to Britain.** *Oil Gas J. 59,* 108 (1961) May 29.

Gas from the Sahara Desert will be liquefied and moved to Great Britain in refrigerated tankers under terms of a deal announced by Continental Oil Co. The gas will be liquefied in a special plant to be constructed at Arzew, near Oran in North Africa. The plant will be built by a company formed by Conch International Methane, Ltd., and French producers—BRP, Air Liquide, and Les Societies de Development Regional de l'Algerie et du Sahara.

**Liquid-Storage Tank.** J. H. Farrell, J. P. Hunsaker and G. Y. Robinson, Jr. (assigned to Conch International Methane Ltd.) U. S. 2,982,441 (1961) May 2.

Improved storage tank for cold liquefied gas is claimed, comprising a polygonal-shaped tank of strong metallic plates and a series of horizontal bracing and reinforcing members welded at vertical intervals to the inner surfaces of the tank walls. Corner bracing members are provided at each horizontal band at the junctures of all adjacent walls, and crossbrace members are extended between opposite walls. This bracing provides strength against deformation under load, regardless of temperature stresses in vertical walls.

**Static Storage of Liquid Methane. Part 1.** C. I. Kelly. *Petrol. Times 65,* 303 (1961) May 5 (4 pp.)

Author first describes earlier static storage tanks, including those of Morrison. Then he discusses the three most recent large tanks, built at Lake Charles, La., for Constock, by Chicago Bridge and Iron Co., and at Canvey Island, England, for the North Thames Gas Board by Whessoe Ltd. and by A.P.V. Article is based on British Patents 840,952 (6-13-60), 854,480 (11-16-60), and 851,568 (10-19-60), respectively.

### Tankers

**Tanker Availability and Requirements: Their Effects on the Tanker Market.** W. L. Newton. *Petrol. 24,* 173 (1961) May (5 pp.)

Today, over half of world oil production is moved by tanker. The biggest pipelines in operation are still about three times as expensive as movement by tanker; thus tankers are preferred unless the distance cut off by pipeline is considerable. The increased size and speed of tankers has meant that total carrying capacity has tended to rise faster than the deadweight tonnage. The effect of this and other factors relating to tanker supply are outlined, followed by a more detailed examination of developments relating to tanker demand, i.e., the ton-mile requirement. On the future position of the tanker market, the author believes that with expanding Saharan production, shortly to be supplemented by Libyan production, the outlook must remain unpromising for some years, although it could improve temporarily if the considerable expansion of demand in 1960 continued through to 1962.

### Underground Storage

**How Sun Oil Co. Mines and Operates LPG Storage Caverns.** P. Dougherty and G. J. Fenix. *Oil Gas J. 59,* 88 (1961) May 22 (3 pp.)

Underground storage of LPG offers significant advantages in comparison with aboveground storage from the standpoints of economy and safety. The oil industry has accepted this fact, and at present there are 36 mined caverns now completed or under construction in the United States. Sun Oil, for example, has three underground caverns mined in granite formations at the Marcus Hook refinery in Pennsylvania. Methods of construction and operation of these caverns are described.

**Hydrate Problems as They Relate to Underground Storage Operations.** N. K. Senatoroff. Paper No. GSTS-61-5. (New York: American Gas Association, May 1961; $0.25)

Author reviews literature from 1888 to present time, and discusses contributions of investigators to the natural gas hydrate problem. Topics covered include composition of natural gas hydrate, prediction of natural gas hydrate formation, field studies, production problems and practices in storage fields, and practical results of the use of scientific studies and field experiences.

**Safety Apparatus for Underground Pressure Fluid Storage.** C. T. Brandt (assigned to Phillips Petrol. Corp.) U. S. 2,981,071 (1961) Apr. 25.

System is claimed for storing a fluid (LPG, propane) under superatmospheric pressure, comprising an underground cavern and a system of pipes for filling and emptying. The pipes comprise four separate units concentrically arranged with O-ring seals, foot-valves and a casing head, which provides liquid and vapor flow connections between cavern and tank cars being filled or emptied.

**Seal Structure for Underground Liquid Storage Facility.** D. H. Seely, Jr. (assigned to Sohio Petrol. Corp.) U. S. 2,981,070 (1961) Apr. 25.

Sealing structure between outlet line and underground storage cavity is claimed. This comprises a spool-shaped metal bulkhead structure, with the enlarged flanges constructed in enlarged trenches in the strata normal to the walls of the outlet passage. After construction by welding, the plates are backed up by concrete pumped in under pressure, and the pipe outlet is sealed by a bolted flanged plate.

**Six Lakes Storage Field in Michigan—A Case History.** J. A. Vary and J. R. Elenbaas. Paper No. GSTS-61-6. (New York: American Gas Association, May 1961; $0.25)

In 1953, Michigan Consolidated Gas Co. acquired all of the remaining interests in the nearly depleted Six Lakes producing gasfield, the largest producing field in the State of Michigan with cumulative production of 51.3 billion CF. Development of the field for storage began almost immediately, and has included drilling 76 new gas storage wells, installing 52 miles of 4- to 24-inch gathering lines, and constructing a dehydration plant and 40,000-hp compressor station. The field has a working storage capacity of 53 billion CF between a base pressure of 175 psig and top pressure of 650 psig. On January 24, 1961 a peak day volume of 778,000 MCF was withdrawn from the field.

**The Underground Storage of Gas in the United States, December 31, 1960.** Compiled by the Subcommittee on Underground Gas Storage Statistics. Paper No. OP-61-1. (New York: American Gas Association, May 1961; $0.25)

Tenth annual report on underground gas storage indicates, for the year 1960, a total capital investment (including physical properties and cushion gas) in excess of $800 million. Tables give data on growth of underground storage in the United States from 1950 to 1960; comparative storage date, 1956-60; storage reservoir data; storage facility data; geological age of storage reservoirs; maximum volumes in storage and maximum day output, 1960; volume in storage; and volume in storage reservoirs.

## 7. MANUFACTURED GAS AND CHEMICAL PROCESSING

### Acetylene

**Process and Apparatus for Treatment of Hydrocarbons.** F. F. A. Braconier and J. J. L. E. Riga (assigned to Societe Belge de l'Azote et des Produits Chimiques due Marly). U. S. 2,978,521 (1961) Apr. 4.

Improved quenching system is claimed for pyrolysis of hydrocarbons to form acetylene. The preheated hydrocarbons pass downward into a reaction chamber, the inner cylindrical wall of which is covered by a downflowing screen of water. At the base of this chamber the wall of water joins with a transverse spray of water, directed downward at 10—15-degree angles, from jets spaced circumferentially around the chamber. This provides a complete quenching screen.

### Aromatics

**Aromatics Outlook: Surplus But No Glut.** H. Pylant and K. Brooks. *Oil Gas J. 59,* 39 (1961) May 22 (2 pp.)

Most recent market survey indicates that aromatics industry's current building boom will not burden producers with a glut of unsalable aromatics. Plants scheduled to go onstream next year will push capacity beyond demand; however, it now appears that processors can run their plants at 80-85 percent of capacity—enough for a payout, but not enough to create a big product surplus. In addition, aromatics producers have one advantage over other processing people—a helpful, built-in flexibility. If, for example, there should be too much benzene, a producer can switch his operations to produce any one of a number of aromatics.

### Carbon Monoxide

**The Reduction of the CO Content of Town Gas.** K. W. Francombe. *Gas World 153,* 626 (1961) May 6 (6 pp.); *Gas Times 95,* 18 (1961) May (3 pp.)

Paper's objective is to show that a limited reduction in the CO content of existing sources of town gas supply is now a practical proposition, and that in suitable circumstances this may be accomplished with only a small increase in the cost of the final gas. When methane becomes readily available (in Great Britain), it may even be carried out at a profit. There is also a concurrent reduction in the organic sulfur content of the gas which thus becomes a much more refined commodity, thereby facilitating gas sales promotion, says author.

### Catalysts

**Compensation Effect and Pressure Dependence for Ethylene Hydrogenation in Contact with Nickel.** J. Tuul and H. E. Farnsworth. *Am. Chem. Soc. J. 83,* 2253 (1961) May 20 (4 pp.)

During a study of the catalytic hydrogenation of ethylene in contact with nickel, a compensation effect was observed. A systematic investigation of this effect was conducted by subjecting the surface of the catalyst to various heat treatments and bombardments with positive argon ions. A linear relationship was found to hold between the logarithm of the frequency factor and the activation energy. The influence of pressure of the reactants was studied. The absolute rate constant and activation energy were found to be only slightly dependent on the pressure of ethylene in the range from 0.02 to 21.7 mm. An approximate relationship between the optimum temperature and ethylene pressure has been deduced.

**Dependence of Activity and Activation Energy on Surface Treatment of Nickel and Copper-Nickel Catalysts.** J. Tuul and H. E. Farnsworth. *J. Am. Chem. Soc. 83,* 2247 (1961) May 20 (7 pp.)

An omegatron rf. mass spectrometer was used in a study of the catalytic hydrogenation of ethylene at low pressures. Experiments were carried out in an ultra high vacuum system where the pressure of the ambient varied between 2 and 6 x $10^{-9}$mm. Four different copper-nickel alloys, as well as pure nickel and pure copper, were used as catalysts. The specimens were made in the form of 0.3 mm sheets of solid material, each having a total surface area of approximately 2.5 $cm^2$. They were cleaned and activated by various heat treatments up to 900°C and by bombardment with positive argon ions. The influence of these treatments on the activation energy was examined. The activation energy for all ion bombarded catalysts was about 11 kcal/mole and was lower after the other treatments. Catalysts subjected to small amounts of gaseous contamination displayed a very low activation energy. The relative activities of the catalysts of various compositions were measured.

**A New Type of Catalyst—Carbon-Expanded Iron.** J. F. Shultz, F. S. Karn, R. B. Anderson and L. J. E. Hofer. *Fuel 40,* 181 (1961) May (12 pp.)

As a part of the Bureau of Mines investigation of the conversion of coal to oil, a new type of Fischer-Tropsch and methanation catalyst—carbon-expanded iron—has been developed. This material is a form of the carbon deposit which often complicates the operation of the conventional catalyst. As observed by electron microscopy, these deposits consist of nuclei of iron to which are attached filaments which consist chiefly of carbon but which may contain some finely dispersed iron. Article presents data to prove that these deposits are catalytically active, but it is not certain which of these structural features are responsible for the catalytic activity.

## Coal

**The Effects of Gamma Radiation on the Extractable Matter in Bituminous Coal.** E. J. Henley and L. Karasyk. *Fuel 40,* 155 (1961) May (5 pp.)

Samples of bituminous B coal, irradiated with cobalt 60 to doses of 108 million roentgens, were extracted with water and pyridine. The *p*H of the water extracts at first increased with dosage, but then leveled off after 50 million roentgens. Mildly acidic water extracts were obtained from unirradiated coal while irradiated coal produced weakly alkaline extracts. In addition, the solubility of the coal in water and in pyridine were maximized at doses near 50 million roentgens. The results are believed to be due to crosslinking and degradation reactions, the latter predominating at the lower doses.

## Coal Carbonization

**The Effect of Fast Neutrons and Gamma Radiation During the Low Temperature Carbonization of Bituminous Coals.** J. A. Hammond and P. L. Walker, Jr. *Fuel 40,* 171 (1961) May (9 pp.)

Eight bituminous coals were irradiated with fast neutrons and gamma radiation while undergoing carbonization at a heating rate of 6°C/minute up to 600°C. The rates of gas evolution and the gas compositions were determined. Irradiation during carbonization was shown to increase the swelling characteristics of the medium- and high-volatile coals, but no significant effect could be detected on the rate of gas evolution or its composition, the type of coke produced, or the yield of tar.

## Coal Gasification

**High-Pressure Coal Gasification Plants in Scotland and Abroad.** T. S. Ricketts. *J. Inst. Fuel 34,* 177 (1961) May (17 pp.)

Article traces the development of the Lurgi high-pressure gasification process; the early experiments which were carried out in what is now Eastern Germany in 1925 and the development work carried out in 1952 on the pilot plant at Oberhausen-Holten are described. Reference is made to the three earliest full-scale Lurgi plants erected at Hinchfelde, Brux and Bohlen; a description is given of the three large Lurgi plants in Germany, South Africa and Australia. Paper concludes with the report on the construction and operation of the Lurgi plant recently completed and put into operation at Westfield, Fife, in Scotland, together with a reference to the associated high-pressure gas grid system designed to transmit town gas at a working pressure of 250 psi.

**Pressure Gasification with Oxygen of Solid Fuels in Germany.** H. Weittenhiller. I.G.E. Comm. No. 589. *Gas World 153,* 732 (1961) May 20 (4 pp.); **Discussion.** *Ibid.,* 92 (1961) May 27; *Gas Times 95,* 25 (1961) May (2 pp.)

Paper describes the practical operation of the coal-gasification plant, using oxygen under pressure, installed by Steinkohlengas AG at Dorsten nearly six years ago. Three main steps were taken to reduce the cost of gas production: 1) the introduction of "dry operation;" 2) the development of crude gas conversion; and 3) the operation of the plant with oxygen-enriched air under specific operating conditions. As a result, the original production cost of the town gas has been reduced by 20 percent.

## Ethylene

**Ethylene Zs at Low Pressures.** B. L. Turlington and J. J. McKetta. *Petrol. Refiner 40,* 245 (1961) May (2 pp.)

Compressibility factors are given for pressures up to 2.0 atmospheres for a temperature range of −22° to 150°F. Second virial coefficients were calculated for the temperatures covered in the investigation, and compared with data presented in the literature for ethylene. The compressibility data are estimated to be accurate within ±0.10 percent of the actual compressibility factor.

**Treatment of Gases.** R. W. Toft (assigned to Engelhard Industries, Inc.) U. S. 2,980,743 (1961) Apr. 18.

Process for removing carbon monoxide from a mixture thereof with ethylene and oxygen is claimed. Method comprises passing the mixture over a rhodium-containing catalyst at a temperature in the range of about 25°-150°C.

## Hydrocarbon Synthesis

**Hydrocarbon Synthesis from Carbon Monoxide and Water Vapor with Nickel Catalysts.** H. Kolbel and J. Gaube. *Erdol u. Kohle 14,* 263 (1961) Apr. (2 pp. German text.)

Synthesis of hydrocarbons is practical at temperatures of about 200°C, a carbon monoxide partial pressure up to 3 atm, and CO-$H_2O$ ratios of 1.5:1 to 3:1. By means of an equation showing the dependence of the reaction rate on partial pressures, it is concluded that the hydrogen pressure along the reaction tube is small. Saturated hydrocarbons are predominantly formed. Without methane, the distribution of the hydrocarbons has a maximum at $C_5$.

## Hydrogasification

**High-Pressure Hydrogasification of Petroleum Oils.** E. B. Shultz and H. R. Linden. *Institute of Gas Technology Research Bull. 29* (1960) Dec. (60 pp.)

Tests with a laboratory batch reactor were made, under the Institute's Basic Research Program, to demonstrate the feasibility of essentially complete conversion of petroleum oils to a methane-rich high-Btu gas. These tests established suitable ranges of pressure, temperature, and hydrogen/oil feed ratio for various types of oil. From the information obtained in batch reactor tests, and a literature study of means for reducing the coke-forming tendency of petroleum oils, a two-step flow unit was designed and constructed under sponsorship of the Gas Operations Research Committee. In the first step, crude and residual oils are upgraded by passage over a catalyst at a temperature below 900°F and in the presence of an excess of hydrogen. This is termed prehydrogenation. In the second step, no catalyst is used. Distillate oil, and prehydrogenated crude and residual oils, are gasified at temperature of 1100° to 1400°F in the presence of the approximate amount of hydrogen required for conversion of the feedstock to methane.

## Hydrogenation

**Process for Purifying Crude Benzene.** E. Sattler (assigned to Koppers Company, Inc.) U. S. 2,981,766 (1961) Apr. 25.

Improved process for hydrogen treatment of crude benzene is claimed, in which coke oven gas is used as a source of hydrogen. The improvement comprises removal of nitrogen oxide impurities in the fresh coke oven gas by reduction at 10-15 atm on a nitrogen-reducing catalyst, and only thereafter adding the fresh gas to the recycle hydrogen stream entering the reactor.

## Oil Gas

**The Activity of Mixed Catalysts and Their Indirect Determination in the Otto Tube Splitting Method.** W. Rothe. *Erdol u. Kohle 14,* 266 (1961) Apr. (2 pp. German text.)

Starting from theoretical concepts of heterogeneous catalysis that have led to the production of different types of catalysts, a method of calculation on a thermodynamic basis is suggested from which a characteristic $K_Z$ can be derived indirectly as a measure of the catalyst performance. A comparison is given between two types, which were tried in technical splitting units of the Otto oil gas process.

## Ore Reduction

**Ore Reduction Process.** T. H. Whaley (assigned to Texaco Development Corp.) U. S. 2,977,216 (1961) Mar. 28.

Process for reduction of metal oxides is claimed, in which the powdered oxide is first contacted with a reducing gas of carbon monoxide and hydrogen to effect partial reduction. The partially reduced ore is mixed with fuel oil and is passed streamwise into a second zone, with addition of steam and oxygen at a temperature above 2000°F. Molten-reduced metal and a hydrogen/carbon monoxide mixture are produced, with the latter returned at 2000°-3000°F to the first reduction zone. Water and carbon dioxide may be removed from the $H_2$/CO mixture before recycling.

**The Use of Natural Gas in the Blast Furnace.** J. G. King. *Coke and Gas 23,* 203 (1961) May (2 pp.)

Author reviews a recent report of the U. S. Bureau of Mines (see *Gas Abstracts 16,* 132) which proposes the addition of natural gas to the blast furnace with the idea of reducing coke consumption and increasing output or driving rate, and so improving the economics of the process. The report's suggestion to use methane to save coke and coking coals may be of interest to the British steel industry if the price of imported methane remains close to current estimates.

## Reformed Gas

**The Automation of Cyclic Gasification of Hydrocarbons as Designed by the S.S.C.** H. J. Hulme and G. Salvi. *Rivista dei Combustibili 15,* 31 (1961) Jan. (9 pp. Italian text.)

Authors report on the criteria followed in developing and building the automatic and safety systems on the cyclic gasification plant for processing light cuts (methane, LPG, refinery gases, straight light distillates), designed at the Stazione Sperimentale per i Combustibili. The requirements that the system had to meet are described, as well as the methods of control employed. In particular, the in-line operations of the automatic processing units are illustrated, showing the extreme flexibility and safety of the equipment in question.

**Gas Production at Romford Works.** D. R. Coote. I.G.E. Comm. No. 594. *Gas World 153,* 757 (1961) May 20 (5 pp.); *Gas Times 95,* 39 (1961) May (4 pp.)

The success in the first three years of operation of the new plants at Romford (North Thames Gas Board, Great Britain), and in particular the refinery gas reforming plant, have justified decisions taken five or six years ago, and have influenced more recent deliberations on the possible construction of additional plants of this type elsewhere. Manufacturers have been challenged to design plants that are low in capital cost, which offer a high degree of reliability, and which can operate with satisfactory efficiencies over a wider range of different feedstocks.

**Production of Town Gas from Refinery Products in MS Reforming Plant.** S. Francis and J. D. Gay. *Gas J. 306,* 189 (1961) May 10 (2 pp.); *Gas World 153,* 659 (1961) May 13 (6 pp.)

Development of large oil refineries in Europe since the war has made available increasing quantities of gaseous and liquid petroleum products. The gas industries of Europe, faced initially with a shortage of coal and with its continually rising price, have found it increasingly attractive economically to consider the use of these hydrocarbons for the production of town gas. In 1955, Gaz de France decided to study the problem to investigate the various processes then in an early stage of development. First experimental pilot MS plant was built (at Sete) and exhaustively tested on the various hydrocarbon feedstocks available. It was known as the Micro Simplex, from which the initials were derived. First commercial plant was built at Sete in 1956, and others followed. Authors discuss application of the MS plant to British practice.

**Thermocatalytic Cyclic Process of S.S.C. for Production of Town Gas from Light Hydrocarbons. (Natural Gas, LPG and Light Distillates.)** C. Padovani and G. Salvi. *Rivista dei Combustibili 15,* 5 (1961) Jan. (26 pp. Italian text.)

For some time, research has been conducted at the Stazione Sperimentale per i Combustibili on the production of town gas from light cuts, with both autothermic and endothermic process. The latter were based on continuous and cyclic techniques. Article describes research techniques and the work done to identify the necessary parameters for designing an industrial plant. Mention is made of the straight light distillates used in Italy which, having a far wider range of distillation than those used elsewhere in Europe and being denatured with fuel oil, raise some problems when employed for gasification purposes.

## Synthesis Gas

**Performance of a Gas-Synthesis Demonstration Plant for Producing Liquid Fuels from Coal.** *U. S. Bur. Mines Rep. Invest. 5803* (Washington, D. C.: U. S. Govt. Print. Off. 1961)

A demonstration plant at Louisiana, Mo., was designed, constructed, and operated to produce gasoline, liquid fuels, and organic compounds from coal by a modified Fischer-Tropsch gas-synthesis process. A 39-day continuous run demonstrated the feasibility of the process. Addition of 3 milliliters of tetraethyl-lead per gallon of upgraded (or finished) gasoline gave a product with an octane rating up to 90 by the research method. After a caustic wash, the diesel oil was of a superior quality; its cetane number was 60 or above. Approximately 1,500,000 SCF of synthesis gas was processed into about 25 bbl of gasoline and 150 gallons of diesel oil per day. The catalyst remained active and synthesis reactions continued, but catalyst disintegration was the major unsolved problem. However, the mechanical difficulties were overcome and commercial plants could probably be designed on the basis of the information obtained.

## Synthetic Rubber

**Isoprene by Dehydrogenation.** A. A. DiGiacomo, J. B. Maerker and J. W. Schall. *Chem. Eng. Progress 57,* 35 (1961) May (6 pp.)

Houdry dehydrogenation process, already commercially proven, has the flexibility required to produce isoprene and/or butadiene in the same dehydrogenation equipment. Thus, a single plant can produce either monomer providing suitable product recovery facilities are available. Article places emphasis on applications of the Houdry process to isoprene production, and describes use of isopentane and a catalytically cracked $C_5$ cut as feedstock.

**Isoprene from Propylene.** V. J. Anhorn, K. J. Frech, G. S. Schaffel and D. Brown. *Chem. Eng. Progress 57,* 43 (1961) May (3 pp.)

Predictions of a natural rubber shortage in the early 60's prompted research on synthetic rubber monomers, particularly isoprene. Rubber consumers were anxious to have a substitute for natural rubber. The discovery of a synthetic route employing isoprene to produce a rubber equivalent in structure to tree rubber offered one way which could be exploited to meet a shortage. Method evolved, after evaluation of several processes, uses the dimer, 2-methyl-l-pentene, followed by isomerization and pyrolysis to obtain isoprene.

**Isoprene Process Evaluation.** V. J. Anhorn, K. J. Frech, J. J. Tazuma, W. E. Morrow and P. H. Wise. *Chem. Eng. Progress 57,* 41 (1961) May (3 pp.)

Objective of program in isoprene research and development was to develop a process which would permit the

production of isoprene at a cost equivalent to that for butadiene. This monomer cost would permit the manufacturer of *cis*-polyisoprene at a maximum cost of about 25 cents/pound which could be competitive with natural rubber. Two main criteria were employed: chemical feasibility of the process and economic evaluation. Five processes finally were evaluated in depth, and it was determined that isoprene-from-propylene appeared to be the best bet.

## 8. GAS DISTRIBUTION

### Automation

**Automation in Gas Industry Operations. Part II.** K. Kridner. *Gas 37,* 68 (1961) May (4 pp.)

Second article in series discusses automation and improved devices for distribution companies on the West Coast of the United States, and deals with concepts inducive to improved systems. In a distribution company, operations modified for automation usually are: 1) telemetering of flow and pressure data; 2) remote instruction for actuation of valve operators; 3) remote starting and operation of gas compressors; 4) automatic logging of data in a central office; 5) use of high-speed computers for calculation of on-line data; and 6) issuance of feedback instructions. Many distribution companies, large and small, utilize automatic equipment for the preceding operations to varying degrees.

**Automation in Gas Industry Operations. Part III.** K. Kridner. *Gas 37,* 111 (1961) June (5 pp.)

Author continues his study of applications of automation within activities of distribution companies. In this installment, he moves his study east of the Rockies, and describes the activities of the Public Service Co. of Colorado (Denver), and Northern Illinois Gas Co. (Bellwood, Ill.)

**The Integration of Automation in the Gas Industry.** N. B. LauBach. Paper No. GSTS-61-7. (New York: American Gas Association, May 1961; $0.25)

Author's premise is that an area of confusion regarding automation exists between management and the engineering and operations group. He suggests a program for gradually introducing automation into any company's operations.

### Dispatching

**Precision Gas Receival at Central Hudson.** W. J. Gunderson. *Am. Gas J. 188,* 30 (1961) June (4 pp.)

Insuring economical use of fuel gas from four separate sources to satisfy the industrial and residential demands of New York State's growing mid-Hudson region requires unusually precise flow control at Central Hudson Gas and Electric Corporation. To transmit and digest system data with the speed necessary for such control, Central Hudson has installed an extensive network of electric telemetering, analog computing, and automatic integrating and printout. System response to operational decisions has been held to a matter of seconds with remote regulator and valve control facilities.

### Leakage

**Mobile Leak Detection Unit.** *Gas 37,* 72 (1961) May (2 pp.)

Oklahoma Natural Gas Co. is field testing a mobile unit with a mechanical sniffer for methane. Unit's infrared detector can smell as little as three parts gas out of every million parts of air. Mobile leakage detection unit needs 2 men; company formerly required 63 men to accomplish the same work. As the truck travels its course, the findings are automatically recorded on graphs. Leakage crews, even with a minimum of training, can study these graphs and know where to make repairs.

**They Watch TV for Hidden Pipeline Leaks.** *Chem. Week 88,* 81 (1961) May 27 (2 pp.)

A television camera has been developed that can be run through sewers while the inspector sits in a truck and watches for leaks and blockages on a television screen. And now the television setup has been prepared for use in chemical plants for inspecting the inside of pipeline and other inaccessible equipment. This equipment has been demonstrated in chemical plants in the Houston, Tex., area. With modifications, the basic equipment can be used to view pipe walls, locate cracks and corrosion, and at the same time spot potential leaks.

### Mains

**Apparatus for Treating High Pressure Gas Systems.** F. E. Blount and J. W. Anthony (assigned to Socony Mobil Oil Co., Inc.) U.S. 2,979,389 (1961) Apr. 11.

Apparatus for injecting a treated liquid as a mist into a high-pressure gasline is claimed. Method comprises a combination of a mainline orifice (for pressure differential), an atomizer on the downstream side of the orifice fed from the liquid feed tank, and a pressure line to force the liquid from feed tank to atomizer, using upstream gas pressure. The apparatus is useful for injection of humidifying agents, lubricants, inhibitors and other materials.

**Repairs on Gas Transmission Mains under Pressure.** E. Ducros. *J. Ind. du Gaz 85,* 163 (1961) Apr. (5 pp. French text.)

Article constitutes first part of a report on the evolution of a repair method on a high-pressure gas transmission main located in an area where the population density and the number of industrial plants are very high.

### Metering

**Metered Systems.** M. Cook. *Butane-Propane News 23,* 80 (1961) May (2 pp.)

Article underscores the usefulness of the vapor meter in solving some of the LPG dealers' most pressing problems in fuel delivery, accounting controls, and stabilization of clientele.

**Periodic Meter Changing. Part 2. Evolution in Trucks.** A. D. Petersen. *Gas 37,* 61 (1961) June (5 pp.)

Two requirements in designing specialized trucks for periodic meter changing work were: 1) sufficient meter carrying capacity, and 2) space for the auxiliary gas supply and the hot meter change device equipment. One stipulation: trucks must be flexible enough to be used for other types of work, such as meter setting. Final decision was to use two types of trucks. One would be a multipurpose type of truck that could be used for routine work as well as periodic meter changes; the other, to be designed specifically for PMC work, would be capable of handling a maximum day's work without returning to the base for additional meters.

### Services

**Service Renewals with Copper Tubing.** R. B. Catell. *Am. Gas J. 188,* 27 (1961) June (3 pp.)

Brooklyn Union Gas Company has completed approximately 31,000 service renewals using copper tubing since the commencement of the service renewal program in 1946. An additional 11,000 are planned in 1961. This economical and rapid method of replacement has enabled Brooklyn Union to renew all services in many of the old areas of its territory. And, the reduction in the number of service leaks occurring each year has, in the company's words, more than justified the continuance of this program.

## 9. GAS FUEL UTILIZATION AND APPLIANCES

### Air Conditioning

**How to Use Natural Gas as the Prime Energy Source for Air Conditioning.** *Heating, Piping & Air Conditioning 33,* 144 (1961) June (9 pp.)

Spurred by unbalanced winter and summer loads and increased supplies of gas in many areas, the gas utilities are encouraging the use of natural gas to power refrigeration machines in air conditioning systems. Development and evolution of gas operated water chilling equipment has paralleled the growth of gas supply and has led to the availability of a wide variety of equipment to take advantage of the competitive situation existing in the energy industries. The designer should be aware of the ways in which gas can be utilized. Direct use of gas for air conditioning may take place in the following types of installations: absorption refrigerating systems; high speed (1200 to 2000 rpm) natural gas engines; steam turbine drives for centrifugal refrigerating systems (3000 rpm for large sizes to 10,000 to 12,000 rpm for smaller size); and gas turbine drive systems.

### Air Pollution

**Dust Collection Methods for Steam Power Plants.** G. Gould. **Part 1.** *Air Eng. 3,* 27 (1961) Apr. (2 pp.); **Part 2.** *Ibid.,* 36 (1961) May (2 pp.)

Article contains specific data on the characteristics of flyash particle size and abrasiveness, and on combining mechanical and electrostatic dust collection units. Also discussed, cost factors to be considered.

**High Temperature Fabric Filtration of Industrial Gases.** P. W. Spaite, D. G. Stephan and A. H. Rose, Jr. *J. Air Pollution Control Assoc. 11,* 243 (1961) May (6 pp.)

Industrial application of fabric filtration of gases was limited for many years by the low thermal resistance of organic filter media; filtration temperatures were restricted to below about 275°F. The introduction of silicone finished glass fabrics just over ten years ago effectively doubled this limit, and glass fiber material remains today the only commercially available fabric in general use for high-temperature gas filtration. Present article attempts to assess the field of industrial filtration over 300°F in a general way, but historically it tends to be dominated by considerations related to fiber glass.

**Operating Procedures Which Help Reduce Air Pollution. Informative Report No. 5.** Committee T1-7. *J. Air Pollution Control Assoc. 11,* 233 (1961) May (2 pp.); **Informative Report No. 6. Legal Limitations on Emissions from Foundry Operations.** *Ibid.,* 234 (3 pp.); **Informative Report No. 7. Available Control Equipment.** *Ibid.,* 236 (5 pp.)

Practices recommended in Report No. 5 should help foundrymen to effect a reduction in emission and localized fall-out of larger particles, and to insure that small particles will be released at maximum plant elevations. In Report No. 6, certain ordinance provisions are outlined which are compatible with foundry operations. A discussion of available control equipment, grouped by type, is contained in Report No. 7.

**Scrubbing of Fume from Combustion Gases at Efficiencies up to 99.98 Percent.** G. M. Hein and A. R. Orban. *J. Air Pollution Control Assoc. 11,* 205 (1961) May (15 pp.)

Results from experiments in which a single operating condition was varied show that collection efficiency of boric oxide fume increases with 1) an increase in the hot-gas velocity at the discharge of the combustor; 2) an increase in the ratio of saturating water to air; 3) an increase in mass flow rate or gas velocity through the subcooler; 4) an increase in ratio of subcooler water to air; and 5) an increase in the ratio of fuel to air.

**Unsolved Problems with Flue-Fed Incinerators.** E. R. Kaiser. *J. Air Pollution Control Assoc. 11,* 254 (1961) May (4 pp.)

Flue-fed incinerator fills a definite need in modern apartment buildings, but it is a recognized source of air pollution in residential areas. Author's purpose is to stimulate consideration of some of the factors in need of investigation in the hope that progress will continue. In some cases, solutions to problems are suggested, but tests will be necessary to determine their full value.

### Burners

**Flame Pulsation Suppressor for Inshot Gas Burners.** R. H. Hara (assigned to General Motors Corp.) U.S. 2,979,126 (1961) Apr. 11.

Pulsation suppressor for an inshot type of burner is claimed, which comprises a pair of radially space coaxial tubes slipped over the end of the burner tube. An annular space is formed between the burner tube and the outer tube; the space is equal in cross-section to the burner tube. This pair of tubes is separated by two welded rings. The inner ring has four arcuate perforations and the outer ring has a number of spaced circular perforations. The tubes and rings form an annular chamber for suppressing air and gas pulsations.

## Cookers

**Whirlpool's Blanket-O-Flame Range Top.** *Appliance Manufacturer 9,* 47 (1961) June (4 pp.)

The Blanket-O-Flame burner developed by the Whirlpool Corporation, St. Joseph, Michigan, marks a big step in gas cooking. Secondary air in the surface unit is blower supplied. This creates a cushion of air between flame and utensil which 1) provides greater temperature control at low to high settings and 2) distributes heat more evenly across the utensil. There are other benefits, too. Power-supplied secondary air eliminates the traditional burner bowl and attendant openings. This makes possible large, clean surfaces beneath the burners.

## Dust

**Apparatus for Filtering Gas.** C. W. Jordan (assigned to United Gas Improvement Co.) U.S. 2,980,204 (1961) Apr. 18.

Filter is claimed for removing from gas extremely minute particles of vapor phase gum and inorganic materials. Such filter comprises a casing with inlet and outlet connections for gas appliances and a porous, glass fiber filter pad element. Fibers of from 0.5-3.0 microns diameter are bonded together by about 30 percent thermosetting resin into a resilient pad. This pad of graduated packing density is designed to outlive the appliance.

## Flame Cultivation

**Flame Cultivation—One Year Later.** W. Clark. *Butane-Propane News 23,* 27 (1961) June (6 pp.)

The High Plains area is a group of 24 or 25 counties in West Texas, up near the Panhandle. It is here that the awakening of flame cultivation has taken place. However, the first crops do not give the full story since the past twelve months have been even more gratifying both with respect to advances in the art as well as in the promotion of this highly important off-season load. Results have been proved on cotton, grain sorghum, and corn. Onions, cabbages, table beets, carrots, bell peppers, and castor beans have had some improvement, but must be proved further. For the soybean crop, flaming will bring good results after the plants are 10 in. tall.

## Flame Research

**Computed Compositions and Thermodynamic Properties of Deuterium-Air Flames.** E. B. Cook and R. W. Smith, Jr. *U.S. Bur. Mines Rep. Invest. 5780.* (Washington, D.C.; U.S. Govt. Print. Off., 1961; 22 pp.)

Studies of flame and combustion phenomena at the Bureau of Mines have been facilitated by computer evaluation of the thermodynamic properties of gases formed by constant-pressure burning. This report is the sixth of a series presenting results of such calculations; it deals also with constant-volume deuterium-air flames.

**Discussion on "Research on Pulverized-Fuel Flames by the International Flames Research Foundation." The Work at Ijmuiden on Pulverized-Fuel Flames up to Mid-1960.** G. G. Thurlow. *J. Inst. Fuel 34,* 202 (1961) May (13 pp.)

Article gives a short account of prior work (see *Gas Abstracts 16,* 211) on pulverized fuel flames conducted at the International Flame Research Station, Ijmuiden, Holland, and of the work conducted subsequently (from 1957 to mid-1960). A summary is given of the general trends of the results now becoming available, the importance of the coal properties, and the burner variables being emphasized. It is concluded that, while the work to date illuminates the more complex nature of these flames as compared with those from liquid or gaseous fuels, it also holds promise of providing the necessary data for understanding the relative importance of the processes occurring in these flames and, therefore, for controlling their combustion and heat transfer properties.

**Influence of Wave Reflections on the Development of Detonation.** A. J. Laderman and A. K. Oppenheim. *Phys. Fluids 4,* 778 (1961) June (5 pp.)

One of the most significant features of the transition from deflagration to detonation is the dynamics of wave interactions occurring in the course of the process. Of particular interest is the effect of waves reflected from the closed end. The present study was based on a streak self-light photograph of a stoichiometric hydrogen-oxygen flame accelerating to detonation, and a simultaneous pressure transducer record taken at the closed end of the tube in the vicinity of the source of ignition. The photograph revealed considerable information on the flow field behind the flame, so that with the additional pressure measurement it was possible to deduce specific data on the changes of state in the gas, and the dynamic effects of wave reflections on the initiation of the process. The results were rationalized by means of a gas wave dynamic analysis yielding sufficiently complete wave diagrams of the phenomena to assess their importance with respect to the transition from deflagration to detonation.

**Propagation of A⇌B→C Flames.** C. F. Curtiss, J. O. Hirschfelder and M. H. Taylor. *Phys. Fluids. 4,* 771 (1961) June (7 pp.)

The equations describing a flame supported by the chemical reaction A⇌B→C are solved by an iterative

procedure using the Arrhenius temperature dependence of the reaction rate constants. It is found that an excellent approximation to a solution is obtained by setting the net rate of production of $B$ to zero. This approximation is a form of the pseudostationary state approximation although $B$ is not necessarily in near equilibrium with the reactant $A$. In addition, explicit solutions are obtained for the temperature and concentration profiles using the ignition temperature approximation for the temperature dependence of the reaction rate constants.

## Industrial Heating

**Automatic Temperature Control for Mobile Applications.** C. W. Pflieger. *LP-Gas 21,* 23 (1961) June (3 pp.)

Mechanical temperature controls to regulate the flow of gas under pressure are finding increasing uses in fields where equipment must be mobile and often remote from power sources such as electricity or compressed air. One typical mobile application is the asphalt or tar kettle trailer used widely for roofing and highway repair work. Leading manufacturers of tar kettles or their components have turned to mechanical gas controls to bring the advantages of automatic control to these operations without relying on instruments requiring short-lived batteries.

**Continuous Hot Dip Galvanizing of Hot-Water Tanks at American-Standard Plant.** *Ind. Heating 28,* 904 (1961) May (4 pp.)

Hot-dip galvanizing of hot-water tanks is performed on a continuous basis by manufacturer, and utilizes a specially designed installation. Once a tank is hung on the overhead monorail conveyor hanger, it is not removed until completely galvanized in the indirect gas-fired galvanizing kettle.

**Continuous Melting and Direct Roll Casting of Aluminum Alloy Sheet at New Plant of Consolidated General.** *Ind. Heating 28,* 868 (1961) May (5 pp.)

Multimillion dollar plant facilities expansion program was recently completed by Consolidated General Products, Inc., Houston, Texas. New plant and equipment features a gas-fired reverberatory melting and holding furnace which contains 40,000 pounds of aluminum alloy at all times. Furnace temperature is controlled at about 1300°F.

**Pattern Heating of Diversified Load in Hood Type Annealing Furnace.** P. F. Berg. *Ind. Heating 28,* 921 (1961) May (4 pp.)

Hood-type furnace at Inland Steel Co.'s Indiana Harbor Works is in constant service, annealing mixed loads of steel sheets, coils, weldments and casting. Continuous operation of the furnace for such applications is possible because of its design. Uniformity of heat input and individual controllability for "tailored heat" are provided by Selas burners arranged in two horizontal rows in the sidewalls of the furnace. Fuel for the furnace is coke oven gas with a Btu content of 540-580/foot. The coke oven gas is premixed with air.

## Pilot Lights

**Pilot Burner.** A. H. Sears (assigned to Harper-Wyman Co.) U.S. 2,980,178 (1961) Apr. 18.

Pilot burner is claimed which includes a sloped screen baffle to guide the burner gas stream above the pilot, and a solid sheet shield covering screen and pilot burner to protect the device from boil-overs.

## Refrigeration

**Frozen Food Industry Sets Goal of Maximum Temperature of 0°F for Handling and Distribution.** E. Sherby. *ASHRAE J. 3,* 79 (1961) June (4 pp.)

When frozen foods first made their appearance, refrigerated storage space that would hold 0°F temperature was, to all intents, practically non-existent. There were no retail cabinets that would hold the necessary low temperatures. There were no railroad cars or trucks capable of hauling the industry's products at temperatures even approximating 0°F. Household refrigerators with separate frozen food holding compartments, not to speak of the home freezer, had yet to be designed. A striking contrast is apparent today. As of 1959, there were some 350,000,000 cu ft of public refrigerated storage space capable of holding frozen foods at below-zero temperatures, as well as an additional 110,000,000 cu ft available in packer chains and distributor warehouses.

## Space Heating

**How to Certify the Safety of Direct-Use HTHW Heating Systems.** W. H. Comtois. *Heating, Piping, and Air Conditioning 33,* 116 (1961) June (5 pp.)

The increasing use of pressurized high- and medium-temperature hot water directly for high temperature-pressure radiation in occupied spaces gives rise to the question of what happens to tenants in the event of a leak. Many qualitative indications of space temperatures and pressures which can develop when leaks occur have been reported. A procedure is presented for calculating space-temperature conditions which will result. Principles developed for protecting the public outside the containment shells of pressurized water nuclear reactors have been extended to cover protection for persons inside a space heated with high-temperature hot water.

**Multi-Zone Unit, Infrared Heaters Provide Comfort for Auto Display and Service.** A. Krapek. *Heating, Piping & Air Conditioning 33,* 121 (1961) June (3 pp.)

An auto agency consisting of two buildings, main show room and office facility, are provided with year-round air conditioning by a multizone unit, as well as a two part service building with attached waiting display room. Service area uses gas-fired infrared heaters to maintain comfort for workmen and customers, with roof ventilators to remove combustion products, and wall louvres to supply outside air to space where doors are opened infrequently.

**Some Impressions of the Domestic Use of Gas in the U.S.A. and Canada.** F. J. Eaton, D. R. Wills and G. H. Fuidge. I.G.E. Comm. No. 592; *Gas World 153,* 740 (1961) May 20 (4 pp.). **Discussion.** *Ibid.,* 838 (1961) June 3 (3 pp.); *Gas Times 95,* 29 (1961) May (3 pp.)

Paper gives in brief some of the information on the domestic use of gas gathered during a short tour of the East and Midwest areas of the United States and eastern Canada. The authors concentrated mainly on the use of gas for space heating in all its aspects, installation, controls and servicing, but the opportunity was taken to examine recent developments in incineration and tumbler dryers. Paper deals essentially with the possible applications of American experience to developments in Great Britain.

**Space Heater.** F. E. Fertig (assigned to Coleman Co.) U. S. 2,982,282 (1961) May 2.

A wall heater is claimed in which a cabinet surrounds the combustion chamber; cool air inlets are provided near the floor level so that the air rises around outside of combustion chamber as it is warmed and passes to an upper chamber. A blower mixes cooler room air with the hot and forces it outward to the room. Aspiration provides continued heat transfer through the walls when the blower is shut off, so that outer walls of the cabinet are always cool.

## 10. EQUIPMENT AND INSTRUMENTATION

### Computers

**How Southern Union Developed a New Program for High-Speed Digital Computers.** A. G. Prasil and R. V. Jebavy. *Gas 37,* 55 (1961) June (6 pp.)

Main objective in the development of a new program was the reduction of professional time required to perform a network analysis. Two areas of possible improvement were suggested. Since the calculation of pipe resistance coefficients is a mathematical operation, it was believed that this could be performed in the routine. Time could also be saved if the initial assumption of flow could be a part of the program. It was hoped that machine calculations could be completed without the presence of a project engineer, and that minor system changes could be made and evaluated with a minimum of effort. System developed utilizes outside consulting agency and its IBM 704 computer.

### Gas Turbines

**The Coal-Burning Closed-Cycle Gas Turbine.** C. Keller and W. Gaehler. *Mech. Eng. 83,* 60 (1961) June (7 pp.)

Since 1956, when the last report on closed-cycle gas-turbine development was presented in the United States, six solid-fuel-fired plants, rated from 2 to 13.5 mw, have come into operation. Additional oil and gas fired installations, both for stationary power plants and ship propulsion, have been built and operated or will soon start operation. Unfortunately, none of these are in the United States. Existing plants reveal gratifying results. The cooling water can be used for area heating, and the simplicity of operation promises successful use in isolated, self-controlled plants. A summarizing report is given on the installations, particularly the coal-fired sets, and a status list is also presented as of the end of 1960.

**Design for Trouble-Free Gas Turbine Operation.** A. H. Carameros. *Pipeline Eng. 33,* D-27 (1961) June (3 pp.)

El Paso Natural Gas Company has racked up more than a million fired hours on 32 gas turbines. Some of the factors to be considered based on operational experience are: automatic sequencing; an inlet filter made of a traveling oil curtain; an easy way of cleaning; and a common lube oil system. Operational feedback used with discretion, and based on performance tests and 8000 hours combustion inspection, should note the following: inlet firing temperature; vibration level; satisfactory measurement of output as the machine ages; and a means of measuring shaft movement both axial and vertical. Maintenance feedback should indicate to some degree the remaining amount of useful life in certain high-temperature components. Many accessories often affect turbine operation, and it is possible that a defective $25 protective device can shut down a million-dollar installation.

### Metering

**More Work from Variable-Head Flowmeters.** G. Bloom. *Prod. Eng. 32,* 50 (1961) June 5 (4 pp.)

The standard meters do nicely if flow and density conditions are "right"—but if conditions are "wrong," should a complex expensive type be used? Seven ways are outlined to make ordinary ones handle jobs beyond their normal limits.

### Operations Research

**Optimize Cyclic Processes.** H. E. Schweyer and F. P. May. *Petro/Chem. Eng. 33,* C-33 (1961) June (6 pp.)

Cyclic operations with a downtime or turnaround period provide an opportunity to apply mathematics to estimate the best cycle for design, or for scheduling when the equipment is already designed. In general, there are two types of optimization—those dealing with maximum average production rate and those dealing with minimum costs. In the first kind of model an optimum production time for a cycle results when the instantaneous production rate decreases with time because the total accumulated production for one cycle when divided by the total cycle time passes through a maximum. In the second kind of model an optimum production results because the total annual costs for a given annual production go through a minimum. The setting up of models for these operations requires development of a background and descriptive vocabulary.

### Temperature Measurement

**New Look at Temperature-Measuring Transducers.** F. Yeaple. *Product Eng. 32,* 49 (1961) May 22 (6 pp.)

Temperatures from almost absolute zero to over 1,000,000°F are now being measured—with reasonable accuracy—in engineering test laboratories throughout the world. As a result, dozens of unusual transducers, previously considered experimental, are helping to solve practical engineering problems. Author's report discusses the state of the art.

**Photoelectric Optical Pyrometer.** J. Middlehurst and T. P. Jones. *J. Sci. Instruments 38,* 202 (1961) May (3 pp.)

Optical pyrometer is described in which the brightness match is performed photoelectrically. A sensitivity of ±0.02°C at 1063°C is achieved with a reproducibility of ±0.1°C.

## 11. MATERIALS OF CONSTRUCTION, AND CORROSION

### Coatings

**Epoxy Resins in Solvent Free Coatings.** P. A. Dunn. *Corrosion Tech. 8,* 133 (1961) May (4 pp.)

A paint which is completely free from evaporating solvents while still retaining the corrosion resistance characteristics of solvent-containing epoxy resin coatings possesses important advantages. The chemical versatility of the terminal epoxy groups enables a large range of chemical hardeners to be employed. Combinations of the epoxy resin-hardener system with coal tar pitches retain the excellent water resistance associated with coal-tar pitch formulations and, at the same time, improve the resistance of the pitch towards aliphatic solvents and virtually eliminate the thermoplasticity of the pitch.

**Plastic Pipe Liner.** N. R. Haskell (assigned to Plastic Insert Lining Co.) U. S. 2,982,311 (1961) May 2.

A plastic liner for pipelines is claimed, which comprises a number of tubing members; each with tapered outer surface at one end and tapered inner surface at other end to form a continuous coupled liner in tandem relationship. An anchoring member between flanges of one pipe length provides a secure seating for the liner at intervals. An expansion section anchored at one pipe flange, permits sliding motion of liner sections at other end primarily for oil pipelines.

**Polyethylene Tape Coating. A Seven-Year Test Report.** M. E. Parker. *Gas 37,* 138 (1961) May (4 pp.)

Continuing test of polyethylene tape as a pipe coating material has now reached seven years' duration, and the performance, says author, is eminently satisfactory. Site of the test is a pair of isolated sections in Seadrift Pipeline Corp.'s Burnell line on the Texas Gulf coastal plain. The line is a high-pressure gas transmission line of 8⅝ inches OD welded steel construction. The two test sections are 12 and 18 miles long. The 12-mile section was coated with polyethylene tape, the 18-mile section with a standard coal tar enamel as a comparison control. Results of testing program are discussed.

### Corrosion

**Electrochemical Principles of the Corrosion and Protection of Metals.** T. P. Hoar. *J. Appl. Chem. 11,* 121 (1961) Apr. (10 pp.)

Types of anode and cathode reactions commonly found in corrosion by aqueous media are described, and the combination of these reactions in corroding and in passivated systems is discussed. The principal ways in which corrosion rates are increased or decreased are classified and discussed in this way: anodic attack and cathodic protection; anodic passivation or protection and cathodic activation; anodic inhibition and stimulation; cathodic inhibition and stimulation; resistance inhibition. The importance of the use of electromechanical and other theoretical principles is emphasized.

**Unity of Anaerobic and Aerobic Iron Corrosion Process in the Soil.** C. A. H. von Wolzogen Kuhr. *Corrosion 17,* 293t (1961) June (7 pp.)

Paper on the unity of the anaerobic and aerobic iron corrosion process in soil was originally presented at the Fourth National Bureau of Standards Soil Corrosion Conference in 1937. It covers such topics as corrosion from an electromechanical point of view, the anaerobic iron corrosion process, iron corrosion by the sulfate reduction process, iron corrosion by carbonic acid reduction process, iron corrosion by nitrate reduction process, iron corrosion due to chemical substances in the soil, and the aerobic iron corrosion process. A statement is made to the effect that the hydrogen acceptor, which is invariably present with all forms of iron corrosion considered, constitutes the unity in the anaerobic and aerobic iron corrosion process in the soil.

### Inhibitors

**Acid Corrosion Inhibition with Secondary Acetylenic Alcohols.** J. G. Funkhouser. *Corrosion 17,* 283t (1961) June (5 pp.)

Secondary acetylenic alcohols (e.g., hexynol, and ethyl octynol) function as corrosion inhibitors specifically in aqueous mineral acids. Extensive laboratory data are presented on the prevention of metallic corrosion in aqueous mineral acids with secondary acetylenic alcohols. Such data point to industrial application in oil well acidizing (protection of API oil well tubing P-105 in 15 percent HCl at 250°F), acid cleaning (protection of aluminum and mild steel in 5 and 15 percent HCl at 150°F and 15 percent $H_2SO_4$ at 187°F). Studies also indicate that hexynol may be used as a component in an inhibitor mixture to prevent corrosion of mild steel by concentrated grades of $H_3PO_4$.

### Plastics

**Plastic Pipes and Pipelines.** C. H. Tetherton. *Chem. and Process Eng. 42,* 208 (1961) May (4 pp.)

Plastic material most widely used as construction material for pipes is unplasticized PVC, which has only been known in America since the end of the second world war. Author reviews the properties and applica-

tions of PVC pipes, especially with respect to existing standards and methods of joining fittings.

## 12. ANALYTICAL METHODS AND TESTS

### Carbon Dioxide

**Carbonic Anhydrase in the Titration of Carbon Dioxide Solutions.** A. L. Underwood. *Anal. Chem. 33,* 955 (1961) June (2 pp.)

Because most of the carbon dioxide in a solution of this gas exists as $CO_2$ and not as carbonic acid, and because the hydration of dissolved carbon dioxide is slow, the titration of carbon dioxide solutions is tedious and the end point is uncertain. The addition of the enzyme carbonic anhydrase, which is known to accelerate the hydration of carbon dioxide, permits rapid titration to a permanent end point. This shortens the process and renders the end point less subjective, thereby improving the precision of the titration. Quantities of enzyme too small to contribute a noticeable titration blank are completely effective.

### Chromatography

**An Apparatus for Preparative-Scale Gas-Liquid Chromatography.** P. V. Peurifoy, J. L. Ogilvie and I. Dvoretzky. *J. Chromatography 5,* 418 (1961) May (12 pp.)

Efficient preparative-scale gas liquid chromatography unit has been developed which features a column of eight 1½-inch x 9-foot tubes connected in series. The tubes are arranged so that the effective column length can be set at 18, 36, 54 or 72 feet. Operation at temperatures up to 250°C, and with sample sizes as large as 20 ml, is practical. Performance studies indicate that separations equivalent to 9000 or more theoretical stages are possible. The unit has been applied to the preparation of narrow concentrates and compounds of high purity for analytical and reaction studies.

### Differential Thermal Analysis

**Effluence Analysis as an Aid to Thermal Analysis.** P. D. Garn and J. E. Kessler, *Anal. Chem. 33,* 952 (1961) June (3 pp.)

Considerable information can be obtained concerning thermal decompositions with simple equipment by combining differential thermal analysis and various gas analysis detectors. The effluent gas from the differential thermal analysis furnace is passed through a thermal conductivity cell or a gas density detector or both. The thermal conductivity or gas density is plotted as a function of temperature simultaneously with the differential temperature. Comparison of the data is useful in ascertaining the nature of the reactions. By careful choice of carrier gases, reaction products can be identified specifically.

### Hydrocarbons

**Combustibles-in-Air Instrument.** S. F. Kapff (assigned to Standard Oil Co.) U.S. 2,980,513 (1961) Apr. 18.

Apparatus is claimed for detecting micro amounts of combustibles in air (for air liquefaction) which comprises accumulative adsorption in a chilled absorbent means from a sample air stream. The adsorption device consists of a coil packed with silica gel (carbon, alumina, molecular sieves) in an insulated closed chamber. Said chamber includes a resistance-wire winding for quick heating, and is surrounded by a separate cooling coil for liquid nitrogen. After the sample has flowed for a while in the cooling coil, the accumulated adsorbed hydrocarbons are flashed off by heating. These are detected by a temperature rise in a platinum filament and by a temperature recorder.

**Infrared Studies of Some New Polycyclic Hydrocarbons and Their Derivatives Containing the Cyclopropyl Ring.** S. A. Liebman and B. J. Gudzinowicz. *Anal. Chem. 33,* 931 (1961) June (4 pp.)

In the infrared analysis of polycyclic hydrocarbons and their derivatives containing the cyclopropyl ring structure, use of the 3050 $cm^{-1}$ and the 1020 $cm^{-1}$ regions as well as the 860 $cm^{-1}$ regions is recommended. However, this analysis has limitations, and consideration must be given to compound type, interfering compounds, and resolving power of the instrument.

### Particle Size

**Particle Size Measurements with an Improved Continuously-Recording Sedimentation Apparatus.** E. S. Palik. *Anal. Chem. 33,* 956 (1961) June (4 pp.)

Improved continuously-recording sedimentation apparatus has been developed and its performance characteristics compared with other methods of particle size analysis. A comparison of the apparatus with two sedimentation methods shows acceptable agreement for a fluorescent powder whereas comparison with a method utilizing changes in electrolytic resistivity shows a significant difference. The apparatus has been found useful in the particle size analyses of fluorescent powders and may be used to analyze other powders with a size distribution in the range of 2 to 60 microns.

### Tars

**Chemical Constitution of Road Tars and Coal Tar Pitches.** L. J. Wood. *J. Appl. Chem. 11,* 130 (1961) Apr. (7 pp.)

Oils derived by the distillation of primary and refined tars and the solvent treatment of pitch have been examined by high-temperature gas-liquid chromatography. The solvent extracts of the pitch have also been analyzed by infrared spectroscopy and for elementary composition. It has been possible to account for a large part of the tar oils as quantities of individual compounds and to indicate the main changes in chemical types associated with the increasing number of rings in the less soluble pitch fractions.

### Temperature Measurement

**International Practical Temperature Scale of 1948.** H. F. Stimson. *J. Research, A. Phys. and Chem. 65,* 139 (1961) May-June (7 pp.)

The International Practical Temperature Scale of 1948 is a text revision of the International Temperature Scale of 1948, the numerical values of temperatures remaining the same. The adjective "Practical" was added to the name by the International Committee on Weights and Measures. The scale continues to be based upon six fixed and reproducible equilibrium temperatures to which values have been assigned, and upon the same interpolation formulas relating temperatures to the indications of specified measuring instruments. Some changes have been made in the text to make the scale more reproducible than its predecessor. The triple point of water, with the value 0.01°C, replaces the former ice point as a defining fixed point of the scale. It is also recommended that the zinc point, with the value 419.505°C, be used instead of the sulfur point. The recommendations include post-1948 data.

## 13. BASIC SCIENCE

### Compressibility

**NMR Measurement of Gas Compressibility.** M. Lipsicas, M. Bloom and B. H. Muller. *J. Chem. Phys. 34,* 1813 (1961) May (2 pp.)

Authors report on a novel method for determining the relative compressibility of gases using nuclear magnetic resonance. This method can be applied over a wide range of temperatures and pressures to all gases with nuclei of nonzero spin. The measurements take a relatively short time and involve a few instrumental corrections. Article is restricted to molecules containing protons, but the method could be generalized to compare molecules with nonidentical nuclei.

### Equation of State

**Linked-Diagram Expansion for the Equation of State of a Gas of Molecules.** A. N. Kaufman and K. M. Watson. *Phys. Fluids 4,* 655 (1961) June (8 pp.)

The method of the linked-diagram expansion is applied to the equilibrium statistical mechanics of a nondegenerate gas of molecules, taking into account the structure of the molecules, and using the Pauli principle for all the electrons. The equation of state is obtained in the form of a virial expansion analogous to that of Ursell and Meyer.

### Fluid Flow

**Flow of Gas Through Porous Media in the Region Between Molecular and Viscous Condition.** E. H. Hirsch. *J. Appl. Phys. 32,* 977 (1961) June (6 pp.)

Experiments on the flow of gases through porous Pyrex disks at pressures in the range of a few mm Hg are described. For air, hydrogen, and carbon dioxide the specific flow is found to be given by $Q = A/(MT)^{1/2} + Bp/\eta T + C[1 - \exp(\alpha_0 - \beta T^{1/2}]\beta p/M^{1/2}$. The significance of this result is discussed.

### Heat Transfer

**Simultaneous Transfer of Heat and Mass.** J. Coates and B. S. Pressburg. *Chem. Eng. 68,* 95 (1961) May 29 (5 pp.)

Humidification, water cooling, drying and a number of other operations involve the simultaneous transfer of heat and matter betwen phases. Interest may be in one transfer or the other, such as in the energy changes in water cooling, or in the mass transfer in dehumidification. However, in all these operations, each transfer influences the other and must be taken into account in designing or analyzing the equipment in which the operation takes place. Authors present method of analyzing and calculating heat and mass transfer, simultaneously, when resistance occurs in the laminar boundary layers between two fluid phases in contact at the interface.

**Theoretical Analysis of Heat Transfer to Gases in Smooth, Round Tubes Under Conditions of Turbulent Flow and High Flux.** J. D. Seader and H. Wolf. *ARS J. 31,* 650 (1961) May (3 pp.)

The development of theoretical equations for predicting the local heat transfer coefficient for fully developed turbulent flow in smooth, circular tubes has been the subject of numerous studies. A comprehensive theory which accounts for the variation of fluid physical properties caused by large radial temperature gradients is the work of Deissler, whose work represents a major advance in heat transfer theory. It has been quite successful in correlating experimental results for the heating of gases. In using the theory, however, there is difficulty in attaching a simple quantitative meaning to the parameter $\beta$, but successful empirical correlations have been made with the parameter $t_w/t_b$ instead of $\beta$. Because of the empirical success of using $t_w/t_b$, a rearrangement of Diessler's equation was investigated to discover a possible theoretical relationship between $\beta$ and $t_w/t_b$.

### Hydrocarbons

**Occurrence, Properties, and Uses of Some Natural Bitumens.** E. P. Carman and F. S. Bayes. *U.S. Bur. Mines Inf. Cir. 7997.* (Washington, D.C.: U.S. Govt. Print. Off., 1961; 42 pp.)

Bureau presents a summary of the occurrence, properties, and uses of some natural bitumens, using layman's terminology or dictionary definition of bitumens—that is, naturally occurring hydrocarbons. Emphasis is on the less solid and semisolid bitumens, particularly those occurring or used to some extent in the United States. This comprises data from many sources, and references to these sources for more detail than is given in the report. Paper was prepared primarily to answer questions about some of the less known bituminous materials.

## Hydrogen

**Condensation of Atomic and Molecular Hydrogen at Low Temperatures.** R. T. Brackmann and W. L. Fite. *J. Chem. Phys. 34,* 1572 (1961) May (8 pp.)

With the use of reflected modulated atomic-beam techniques, the reflection of hydrogen atoms and molecules at cold surfaces has been examined. It was found that at low temperatures ($\sim$4°K), hydrogen atoms reflect as atoms with a very high probability. The reflection of hydrogen molecules is strongly dependent upon the amount of water vapor condensed on the target prior to and simultaneously with the $H_2$. The fact that condensation of stable gases can be affected by simultaneous condensation of water vapor at temperatures exceeding the normal boiling points of the gases leads to an application in the form of an extraordinarily inexpensive way to produce vacuums in the $10^{-5}$ mm Hg range.

**Production of Low Tritium Deuterium.** J. S. Drury, R. H. Guymon and E. F. Joseph. *Chem. and Process Eng. 42,* 220 (1961) May (5 pp.)

Article is based on work performed for the U.S. Atomic Energy Commission to obtain high-purity deuterium. A small, electrolytic facility for separating tritium from deuterium was designed and operated, and more than 400 kg of deuterium oxide and about 70,000 litres of deuterium gas were purified. The average ratio of tritium to deuterium in the product was $6 \times 10^{-16}$. The purified deuterium can then be used in bubble-chamber experiments.

## Kinetics

**Kinetics of a Typical Gas-Solid Reaction.** W. D. Baasel and W. F. Stevens. *Ind. Eng. Chem. 53,* 485 (1961) June (4 pp.)

Kinetics of the reaction between two substances, one solid and one gaseous, giving rise to a solid product, have been analyzed mathematically. The resulting relationships give the concentrations of the solid and gaseous reactants as functions of both bed position and time. A chart is presented which simplifies the use of the mathematical equations developed. Experiments designed to test the applicability of the theoretical relationships are described and their results summarized. A successful correlation of the rate constants obtained for the limited range of operating conditions is presented.

## Methane

**Near-Infrared Absorption Spectrum of Solid Methane at the λ Point.** J. A. Glasel. *J. Chem. Phys. 34,* 1649 (1961) May (4 pp.)

Observations on the near-infrared absorption spectrum of solid methane in the region of $\nu_1 + \nu_4$ and $\nu_3 + \nu_4$ over a temperature range of $6° - 33°$K are presented and discussed. There is no evidence of molecular rotation, and the observations are shown to lead to an interpretation involving an order-disorder transition. Approximate *f* numbers for the transitions are measured.

## Viscosity

**Viscosity of Two-Component Gaseous Mixtures.** J. O. Hirschfelder, M. H. Taylor, T. Kihara and R. Utherford. *Phys. Fluids 4,* 663 (1961) June (6 pp.)

The conditions are found where the viscosity of a binary mixture of dilute gases either has a maximum or minimum with respect to variations in the composition. A maximum in the viscosity is most likely to occur for a mixture of a polar and nonpolar gas in which the viscosities of the pure components are nearly equal and their molecular weights are quite different. A minimum should occur for a mixture of two nonpolar gases in which both the viscosities and molecular weights of the pure components are nearly equal. There are 17 experimental examples of maxima (and three additional mixtures with predicted maxima) in the viscosity but up to the present time no cases have been discovered where the viscosity has a minimum. A comparison between theory and experiment shows excellent agreement for the viscosity of binary mixtures.

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*Chemical Processing*
*Chemical Reviews*
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*Gas Council Research Communications* (British)
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*Gas Industries*
*Gas Journal* (British)
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*Industrial Finishing* (British)
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